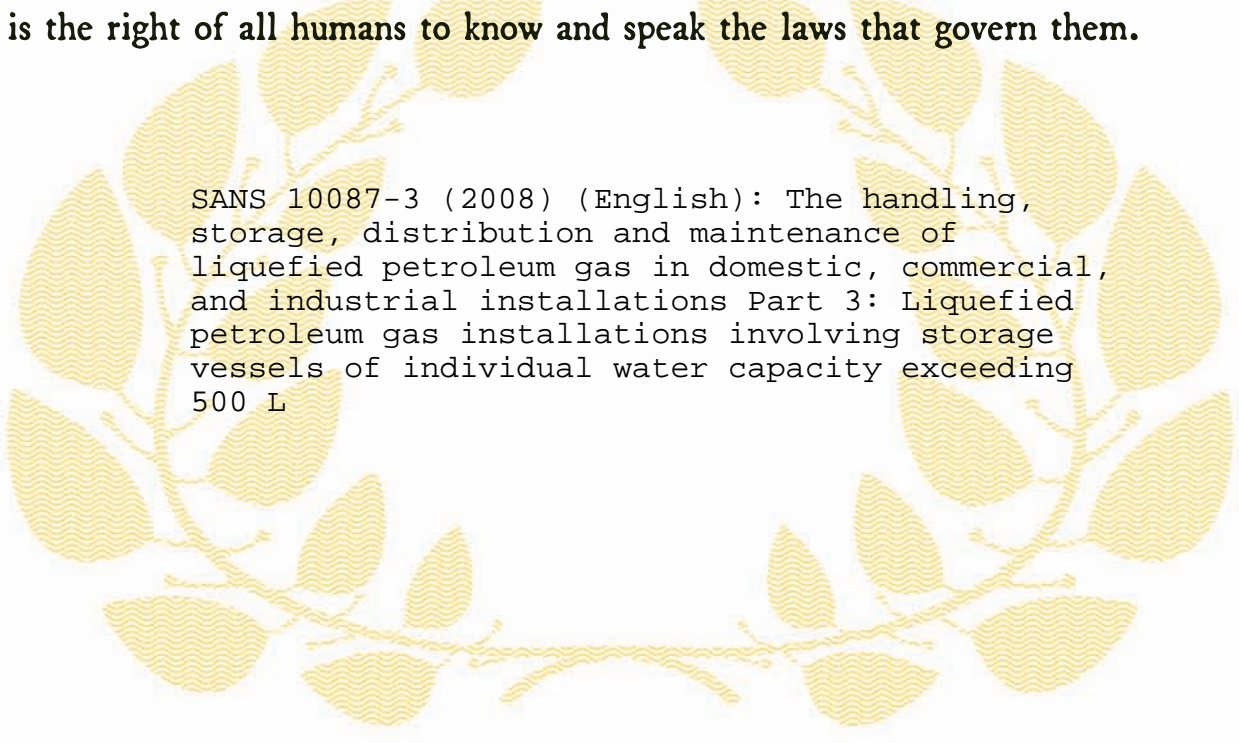




# *Republic of South Africa*

## EDICT OF GOVERNMENT

In order to promote public education and public safety, equal justice for all, a better informed citizenry, the rule of law, world trade and world peace, this legal document is hereby made available on a noncommercial basis, as it is the right of all humans to know and speak the laws that govern them.



SANS 10087-3 (2008) (English): The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations Part 3: Liquefied petroleum gas installations involving storage vessels of individual water capacity exceeding 500 L



BLANK PAGE



## **SOUTH AFRICAN NATIONAL STANDARD**

**The handling, storage, distribution  
and maintenance of liquefied petroleum  
gas in domestic, commercial, and  
industrial installations**

**Part 3: Liquefied petroleum gas installations  
involving storage vessels of individual water  
capacity exceeding 500 L**

**SANS 10087-3:2008**  
Edition 4

**Table of changes**

Change No.	Date	Scope

**Acknowledgement**

Standards South Africa wishes to acknowledge the valuable assistance derived from publications of the following organizations:

British Liquefied Petroleum Gas Industry Technical Committee  
British Standards Institution  
Mobil Oil Southern Africa (Pty) Ltd  
National Fire Protection Association (USA)  
Shell and BP Service Company (Proprietary) Ltd  
LPG Association (UK)  
The Institute of Petroleum (UK)  
The Institute of Engineers (UK)

**Foreword**

This South African standard was approved by National Committee StanSA SC 5120.19A, *Gas supply, handling and control (fuel and industrial gases) – Fuel gases*, in accordance with procedures of Standards South Africa, in compliance with annex 3 of the WTO/TBT agreement.

This document was published in April 2008. This document supersedes SANS 10087-3:2004 (edition 3.2).

SANS 10087 consists of the following parts, under the general title *The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations*:

*Part 1: Liquefied petroleum gas installations involving gas storage containers of individual water capacity not exceeding 500 L and a combined water capacity not exceeding 3 000 L per installation.*

*Part 2: Installations in mobile units and small non-permanent buildings.*

*Part 3: Liquefied petroleum gas installations involving storage vessels of individual water capacity exceeding 500 L.*

*Part 4: Transportation of LPG in bulk by road.*

*Part 6: The application of liquefied petroleum and compressed natural gases as engine fuels for internal combustion engines.*

*Part 7: Storage and filling premises for refillable liquefied petroleum gas (LPG) containers of gas capacity not exceeding 9 kg and the storage of individual gas containers not exceeding 48 kg.*

## **Foreword** *(concluded)*

*Part 8: The fuelling of fork lift trucks and other LP gas operated vehicles.*

*Part 10: Mobile filling stations for refillable liquefied petroleum gas (LPG) containers of capacity not exceeding 9 kg.*

This document was written in order to support a specific South African Regulation and, of necessity, includes references to South African legislation. It therefore might not be suitable for direct application in other jurisdictions where conflicting legislation exists.

Annex B forms an integral part of this document. Annex A is for information only.

## **Introduction**

This document represents a minimum standard. Compliance with it does not confer immunity from relevant legal requirements. Where mandatory requirements are applicable, the authority having jurisdiction, i.e. the approving authority (see 3.3) should be approached.

This document is called up in the Vessels Under Pressure Regulations of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) making the requirements of this document mandatory.

**SANS 10087-3:2008**

Edition 4

**This page is intentionally left blank**

## Contents

	Page
Acknowledgement	
Foreword	
Introduction .....	1
<b>1</b> Scope .....	5
<b>2</b> Normative references .....	5
<b>3</b> Definitions .....	7
<b>4</b> Properties of LPG and precautions to be observed for storage vessels .....	9
<b>5</b> Construction and design .....	10
<b>5.1</b> General .....	10
<b>5.2</b> Design temperature for buried or mounded storage vessels .....	10
<b>5.3</b> Branches and manholes .....	10
<b>5.4</b> Fittings .....	10
<b>5.5</b> Mountings and supports .....	13
<b>5.6</b> Finish and marking .....	13
<b>5.7</b> Initial inspection, testing and certification .....	14
<b>6</b> Location of storage vessels .....	14
<b>6.1</b> Risk assessment .....	14
<b>6.2</b> Above-ground storage vessels .....	15
<b>6.3</b> Buried and mounded storage vessels .....	15
<b>6.4</b> Safety distances .....	15
<b>6.5</b> Enclosure of area .....	17
<b>6.6</b> Warning notices .....	17
<b>6.7</b> Installation .....	18
<b>6.8</b> Piping .....	19
<b>6.9</b> Valves and other fittings .....	19
<b>7</b> Commissioning and decommissioning of bulk tank installations .....	20
<b>7.1</b> Commissioning and certificate of compliance .....	20
<b>7.2</b> Decommissioning of storage vessels .....	20
<b>8</b> Filling ratios and volumes of storage vessels .....	20
<b>8.1</b> Filling ratios .....	20
<b>8.2</b> Filling by volume .....	21
<b>9</b> Ongoing inspection, testing and certification of vessels .....	22
<b>10</b> Testing for leaks .....	22

**Contents** *(concluded)*

	Page
<b>11</b> Fire hazard control .....	22
<b>11.1</b> Fire safety .....	22
<b>11.2</b> Passive protection .....	22
<b>11.3</b> Fire protection .....	23
<b>11.4</b> Rational design .....	25
<b>11.5</b> Protection against static electricity (inductive sparking) .....	25
<b>11.6</b> Gas detection systems .....	25
<b>12</b> Vaporizers .....	25
<b>12.1</b> General .....	25
<b>12.2</b> Safety distances .....	26
<b>12.3</b> Design and construction .....	27
<b>12.4</b> Fittings .....	27
<b>13</b> Periodic inspection, retesting and maintenance .....	28
<b>14</b> Electrical equipment and other sources of ignition .....	28
<b>15</b> Filling point for bulk storage vessels .....	30
<b>16</b> Filling of portable containers (up to 500 L water capacity) .....	30
<b>17</b> Container storage areas .....	30
<b>18</b> Filling sheds for portable containers .....	31
Figures 1 to 5 .....	32-37
<b>Annex A</b> (informative) Rate of discharge of pressure relief devices .....	38
<b>Annex B</b> (normative) Storage and dispensing of LPG as an automotive fuel at service stations or dedicated automotive fuel LPG dispensing sites .....	40
<b>Bibliography</b> .....	48



## **The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations**

### **Part 3:**

Liquefied petroleum gas installations involving storage vessels of individual water capacity exceeding 500 L

## **1 Scope**

**1.1** This part of SANS 10087 specifies requirements for the layout, design and installation of butane, propane and liquefied petroleum gas equipment, and of storage vessels of individual water capacity exceeding 500 L and associated vaporizers, pipework and fittings up to the outlet of the first pressure reduction stage in the line.

It also specifies requirements for the fitting of automatic and other devices (operative in the event of physical damage to the installation) for the purpose of ensuring maximum security, for the storage of gas from a design point of view, and for limiting the escape of liquid through normal pressure relief fittings.

**1.2** It covers provisions for underground and above-ground liquefied petroleum gas (LPG) storage tanks and associated equipment, such as pumps, dispensers and pipework at service stations, container filling sites and consumer installations.

**1.3** It also covers dedicated LPG dispensing stations.

**1.4** It does not cover refrigerated LPG storage.

NOTE For information in this regard refer to international requirements.

## **2 Normative references**

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. Information on currently valid national and international standards can be obtained from Standards South Africa.

API Spec 5L, *Specification for line pipe*.

ASME BPVC Section VIII Division 1, *Boiler and pressure vessel code – Section VIII: Rules for construction of pressure vessels – Division 1: Pressure vessels*.

BS 1600, *Specification for dimensions of steel pipe for the petroleum industry*.

## **SANS 10087-3:2008**

Edition 4

EN 1759-1, *Flanges and their joints – Circular flanges for pipes, valves, fittings and accessories, class designated – Part 1: Steel flanges, NPS ½ to 24.*

EN 1762, *Rubber hoses and hose assemblies for liquefied petroleum gas, LPG (liquid or gaseous phase), and natural gas up to 25 bar (2,5 MPa) – Specification.*

IP 250/69, *Petroleum measurement tables – Metric units of measurement based on a reference temperature of 20 °C.*

ISO 3183, *Petroleum and natural gas industries – Steel pipe for pipeline transportation systems.*

NFPA 58, *Liquefied petroleum gas code.*

PD 5500, *Specification for unfired fusion welded pressure vessels.*

SANS 460, *Plain-ended solid drawn copper tubes for potable water.*

SANS 1020, *Power-operated dispensing devices for flammable liquid fuels.*

SANS 1056-1 (SABS 1056-1), *Ballvalves – Part 1: Fire-safe valves.*

SANS 1142 (SABS 1142), *Diesel engines modified for use in hazardous locations (other than in mines).*

SANS 1186-1, *Symbolic safety signs – Part 1: Standard signs and general requirements.*

SANS 1535, *Glass-reinforced polyester-coated steel tanks for the underground storage of hydrocarbons and oxygenated solvents and intended for burial horizontally.*

SANS 10086-1, *The installation, inspection and maintenance of equipment used in explosive atmospheres – Part 1: Installations including surface installations on mines.*

SANS 10087-1, *The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations – Part 1: Liquefied petroleum gas installations involving gas storage containers of individual water capacity not exceeding 500 L and a combined water capacity not exceeding 3 000 L per installation.*

SANS 10087-6, *The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations – Part 6: The application of liquefied petroleum and compressed natural gases as engine fuels for internal combustion engines.*

SANS 10087-7, *The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations – Part 7: Storage and filling premises for refillable liquefied petroleum gas (LPG) containers of gas capacity not exceeding 9 kg and the storage of individual gas containers not exceeding 48 kg.*

SANS 10087-8 (SABS 087-8), *The handling, storage, and distribution of liquefied petroleum gas in domestic, commercial, and industrial installations – Part 8: The fuelling of fork lift trucks and other LP gas operated vehicles.*

SANS 10089-1, *The petroleum industry – Part 1: Storage and distribution of petroleum products in above-ground bulk installations.*

SANS 10089-2, *The petroleum industry – Part 2: Electrical and other installations in the distribution and marketing sector.*

SANS 10089-3 (SABS 089-3), *The petroleum industry – Part 3: The installation of underground storage tanks, pumps/dispensers and pipework at service stations and consumer installations.*

SANS 10108, *The classification of hazardous locations and the selection of apparatus for use in such locations.*

SANS 10139, *Fire detection and alarm systems for buildings – System design, installation and servicing.*

SANS 10142-1, *The wiring of premises – Part 1: Low-voltage installations.*

SANS 10232-1, *Transport of dangerous goods – Emergency information systems – Part 1: Emergency information system for road transport.*

SANS 10400 (SABS 0400), *The application of the National Building Regulations.*

### **3 Definitions**

For the purposes of this document, the following definitions apply.

#### **3.1**

##### **acceptable**

acceptable to the approving authority

#### **3.2**

##### **approved**

approved by the approving authority

#### **3.3**

##### **approving authority**

appropriate of the following:

- a) within the scope of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993): the Chief Inspector;
- b) within the scope of SANS 10400: the local authority concerned;
- c) in terms of the Trade Metrology Act, 1973 (Act No. 77 of 1973): the Director of Trade Metrology;
- d) within the scope of the Mine Health and Safety Act, 1996 (Act No. 29 of 1996), and in respect of the control of general safety: the Chief Inspector

#### **3.4**

##### **capacity**

total water capacity of the storage vessel

#### **3.5**

##### **competent person**

any person that has the knowledge, training and experience specific to the work or task being performed

#### **3.6**

##### **design pressure**

pressure used for calculating the minimum shell thickness of the storage vessel

#### **3.7**

##### **dispenser**

device or system designed to measure and transfer LPG into permanently mounted fuel containers on vehicles

NOTE This serves the same purpose as the petrol dispenser in service stations.

**3.8**

**diversion wall**

wall erected with the specific purpose of ensuring and maintaining the appropriate safety distances between the point of gas release and any drains, doors and windows in buildings, and any possible source of ignition, for example electrical apparatus

**3.9**

**filling ratio**

ratio of the mass of LPG introduced into a storage vessel to the mass of water (determined at, or corrected to, 20 °C) that would fill the storage vessel

NOTE The term 'filling ratio' applies when the filling of a liquefied gas into a storage vessel is controlled by the mass of the gas introduced.

**3.10**

**firewall**

solid wall or other barrier of height at least 1,8 m, and with a fire rating of not less than 2 h, constructed and placed with the object of preventing the spread of fire

**3.11**

**hazard**

threat of rupture or other failure of a storage vessel to surroundings within a radius of (nominally) 0,5 km of the storage vessel (see SANS 10232-1)

NOTE Hazards will normally vary proportionately with the concentration of property or people within this radius, as well as with the capacity of the storage vessel expressed as a factor of risk in relation to the probability of the hazard.

**3.12**

**liquefied petroleum gas**

**LPG**

commercial butane, commercial propane, or a mixture of light hydrocarbons (predominantly propane, propene, butane and butene) that is gaseous under conditions of ambient temperatures and pressure, and that is liquefied by an increase of pressure or a lowering of temperature

**3.13**

**LPG dispensing station**

service station (forecourt)

fixed equipment where LPG is stored and dispensed into non-cargo containers that are mounted on vehicles

NOTE The public may be permitted access to the dispensing station.

**3.14**

**point of transfer**

location where connections and disconnections are made and where LPG is vented to the atmosphere in the course of transfer operations

**3.15**

**registered installer**

person that has the ability, appropriate training, knowledge and experience to carry out the work that is undertaken in a safe and proper manner, and who is registered in accordance with the requirements of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993)

**3.16**

**risk**

likelihood of a storage vessel being exposed to damage, gas escape, radiant heat and similar dangers

NOTE Risk is independent of the capacity of a storage vessel and represents an evaluation of the effect that external circumstances could have upon the storage vessel.

**3.17****safe working pressure**

maximum gauge pressure, at the coincident metal temperature, that is permitted for a storage vessel when in operation

**3.18****storage vessel**

bulk tank

horizontal or vertical storage vessel of capacity exceeding 500 L and of the above-ground, buried, mounded (semi-buried) or semi-mounded type

**3.19****vapour barrier**

wall or other barrier of height at least 500 mm, constructed and placed with the object of preventing the passage of vapour from any one place to another

## **4 Properties of LPG and precautions to be observed for storage vessels**

The location of LPG vessels shall be planned and put into effect with full regard for the properties of the gas and the construction of installations for conveying this gas in domestic dwellings and commercial buildings. All persons concerned with the installation of vessels and appliances shall be registered installers in this respect and shall be familiar with the following characteristics of the gas and the precautions to be observed:

- a) The gas is stored as liquid under pressure.
- b) Leakage, especially of liquid, will release large volumes of highly flammable gas.
- c) A gas-air mixture that contains approximately 1,5 % to 10 % of LPG is flammable. If a large enough volume of gas is so dispersed in the atmosphere as to reach flammable proportions throughout, ignition of the mixture will result in a rate of combustion of near-explosive force.
- d) LPG is denser than air and will flow along the ground or through drains. It can be ignited at a considerable distance from the source of leakage, therefore low-level ventilation shall be provided.
- e) LPG is non-toxic, but since it can induce headaches and dizziness when inhaled, inhalation of LPG should be avoided whenever possible.
- f) LPG liquid, by its rapid vaporization and consequent lowering of the temperature, can cause severe cold burns when it comes into contact with the skin. Appropriate protective clothing, such as gloves, goggles, aprons, and gumboots, shall be worn when there is any possibility of such contact. Because of the hazard of the generation of static electricity, the soles of gumboots shall be made of leather or conductive rubber, and clothing shall not be made of fabrics that contain artificial fibres.
- g) A storage vessel that has held LPG and is presumed to be "empty" can still be hazardous. In this state, the internal pressure is approximately atmospheric and, if the valve leaks or is left open, air can diffuse into the storage vessel and form a flammable or explosive mixture. Furthermore, even an "empty" storage vessel that does not yield gas when the valve is opened, might in fact not be quite empty. In cold weather, the heavier fractions of the liquid might not vaporize and will therefore remain in the storage vessel. All vessels that are (or appear to be) empty shall be handled with the same care as a full storage vessel.
- h) Valves shall be kept fully closed at all times when storage vessels are not in use.

- i) Because of the hazards involved with the filling of storage vessels, no one shall fill a storage vessel with gas unless such a person
  - 1) is fully conversant with the relevant requirements of this part of SANS 10087,
  - 2) is satisfied that the storage vessel complies with the requirements of an approved manufacturing standard (if necessary, this may be ascertained from the relevant storage vessel documents),
  - 3) employs staff trained and experienced in the pre-filling inspection and actual filling of storage vessels with those gases that are handled,
  - 4) ensures that the storage vessel is not due for periodic inspection or testing, and
  - 5) is aware of the emergency procedures in the event of spillage and fires.
- j) Permission to fill the storage vessel has been granted by the owner of the storage vessel.

## **5 Construction and design**

### **5.1 General**

Storage vessels shall be designed and constructed in accordance with an approved standard (for example, PD 5500 and ASME BPVC Section VIII Division 1).

The design temperature for all LPG storage vessels shall be at least  $-20\text{ }^{\circ}\text{C}$ .

NOTE A typical above-ground LPG storage vessel is shown in figure 1.

### **5.2 Design temperature for buried or mounded storage vessels**

#### **5.2.1 Maximum design temperature**

The maximum design temperature for a buried or mounded storage vessel shall be the maximum product filling temperature or  $38\text{ }^{\circ}\text{C}$ , whichever is the greater.

#### **5.2.2 Minimum design temperature**

The minimum design temperature for a buried or mounded storage vessel shall be the minimum expected temperature of the surrounding ground or  $-20\text{ }^{\circ}\text{C}$ , whichever is the lower.

### **5.3 Branches and manholes**

**5.3.1** Couplings, branches and manholes shall comply with the requirements of this part of SANS 10087 in accordance with which the storage vessel is constructed.

**5.3.2** Branches shall be flanged but the couplings of any screwed connections shall comply with an approved standard in respect of design and pressure rating.

### **5.4 Fittings**

#### **5.4.1 General**

**5.4.1.1** All fittings for LPG service shall be acceptable for use at the safe working pressure of the storage vessel concerned.

**5.4.1.2** All equipment, such as storage equipment, vaporizers, pumps and pipelines, shall be electrically bonded and earthed (see 11.5).

As soon as any LPG installation (or any extension to it) has been completed, all parts of the system shall be tested for electrical continuity and resistance to earth, which shall not exceed 10  $\Omega$ , and a certificate of compliance shall be issued by a competent person as defined in the Vessels Under Pressure Regulations in the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).

#### **5.4.2 Connections for filling, withdrawal and equalizing**

**5.4.2.1** Manually operated primary shut-off valves (see 6.9) shall be fitted on all liquid and vapour connections with the following exceptions:

- a) openings to which safety relief valves are fitted;
- b) openings protected by a controlling orifice of diameter not exceeding 1,4 mm;
- c) plugged openings;
- d) openings fitted with approved gauging devices;
- e) filling connections mounted directly on storage vessels of capacity not exceeding 9 000 L, provided that the opening is fitted with a non-return/excess-flow valve combination or one double non-return valve or two single non-return valves; and
- f) openings fitted with quick-closing internal shut-off valves (see 5.4.2.4).

The shut-off valve shall be fitted as close to the storage vessel as is practicable except that where there is no mechanical joint between the shut-off valve and the storage vessel and the inter-connecting piping is designed, constructed and tested in accordance with the design standard used for the storage vessel, the valve can be located at the downstream end of that length of piping.

**5.4.2.2** All liquid and vapour connections, with the exception of those listed in 5.4.2.1(a) to 5.4.2.1(e) inclusive, and drain openings (see 5.4.2.6) shall be fitted with an emergency shut-off valve (e.g. an excess-flow valve, an automatically operated valve, a remote-controlled valve or a non-return valve). Emergency shut-off valves and non-return valves are not considered necessary if the bore of the connection to the storage vessel does not exceed 3 mm in the case of liquid and 8 mm in the case of vapour.

**5.4.2.3** If the emergency shut-off valve (see 5.4.2.2) is of the excess-flow type, its closing flow rate should be below that likely to result from a complete fracture of the line it is protecting (calculated under the most adverse conditions likely to be experienced), but in no case shall it exceed 1,5 times the design flow rate for the line.

Excess-flow valves shall have a rated closing capacity sufficiently higher than the normal flow requirements so as to prevent valve chatter.

**5.4.2.4** A quick-closing internal shut-off valve (see 5.4.2.1(f)) can be used to give more positive protection in a storage vessel opening than is afforded by an excess-flow valve alone. Quick-closing internal valves shall be so arranged as to give at least one point for thermal closure (by actuation of the heat-sensing device) and at least one point for manual closure from a safe remote position. Such valves shall be kept closed when the line they serve is not in actual use.

**5.4.2.5** If the filling connection is remote from the storage vessel, a non-return valve shall be fitted in the liquid line at a distance not exceeding 500 mm from the filling connection, and an excess-flow valve (similarly located) shall be fitted in the vapour return line, if relevant.

Remote storage vessel filling points and vapour connections shall, in addition, have emergency shut-off valves, bleeder valves and terminal caps placed within 500 mm of the filling point. Flow indicators can be included, if desired.

**5.4.2.6** Each drain connection (see figure 1) shall, in accordance with 5.4.2.1, have a ball-type, fire-safe shut-off valve of nominal size preferably limited to a maximum of 50 mm and that complies with SANS 1056-1. This shut-off valve shall be connected direct to a length of piping that terminates in a second shut-off valve of nominal size not exceeding 18 mm.

The length of piping between the valves shall be of length at least 1 m and such that the risk of simultaneous obstruction of both valves is minimized. On the downstream side, the second valve shall be connected to piping that is long enough to ensure that discharge will not take place beneath the storage vessel. The end of the pipe shall be closed by means of a screw plug. The second valve and all the piping shall be so supported and secured as to prevent failure. The means of actuation of both drain valves shall be such that they cannot be removed (or moved from the closed position) except by intentional operation.

### **5.4.3 Pressure relief valves**

**5.4.3.1** Each storage vessel shall be equipped with at least two pressure relief valves. Each pressure relief valve shall have direct communication with the vapour space of the storage vessel. This can be accomplished by the use of a multi-port device. A number of pressure relief valves can be combined to constitute one multi-port device.

If any one valve is inoperative, the number and size of the remaining pressure relief valves shall be sufficient to provide the full relief flow capacity (see annex A) required for the storage vessel (see 5.4.3.2).

**5.4.3.2** The maximum start-to-discharge pressure of the relief valve shall not be higher than 110 % of the design pressure of the storage vessel. Each pressure relief valve shall be of such design that it reseats at a pressure not less than 90 % of the start-to-discharge pressure.

**5.4.3.3** In storage vessels of capacity exceeding 9 000 L, vent pipes shall be fitted to the relief valve outlets. These pipes shall project vertically upwards (terminating not less than 2 m above the storage vessel) and shall discharge, without obstruction, to the open air. Each vent pipe shall be equipped with a loose-fitting rain cap that is held in place by a length of light chain or flexible wire. If liquid drain holes are required in vent pipes, such holes shall be so positioned that jets of fluid cannot impinge on the shell or on any fitting to the storage vessel.

**5.4.3.4** Pressure relief devices shall be such that it is not possible to tamper with the relief valve settings.

**5.4.3.5** Shut-off valves shall not be installed between a storage vessel and any pressure relief device/valve.

**5.4.3.6** Provision can be made to isolate any relief valve for testing or servicing provided that the remaining relief valves provide the full relief capacity (see annex A).

**5.4.3.7** Each pressure relief valve shall be clearly and permanently marked with the following:

- a) the pressure at which the valve is designed to start to discharge;
- b) the actual air discharge rate of the valve, in cubic metres of air per minute at normal temperatures and pressure, at 120 % of the set pressure; and
- c) a serial number.

**5.4.3.8** Each pressure relief valve on a storage vessel shall be re-certified within a period of three years, and shall be sealed and stamped with the date of testing and the identification mark of the testing station.



#### **5.4.4 Contents gauges**

**5.4.4.1** Each storage vessel shall have a contents gauging device (mechanical or electrical) and a device for indicating the maximum liquid level.

**5.4.4.2** Each liquid level indicator shall be appropriate for operation at the maximum allowable operating pressure of the storage vessel that it serves.

**5.4.4.3** Each gauging device (such as a rotary tube, a fixed tube or a slip tube) that relies on bleeding to the atmosphere shall be so designed that

- a) unless it is protected by an emergency shut-off valve, the maximum diameter of the bleed hole does not exceed 1,4 mm,
- b) it cannot be completely withdrawn in normal gauging operations, and
- c) the gland is capable of being repacked while the storage vessel is in service.

**5.4.4.4** Each maximum liquid level indicating device shall be appropriate for use with the LPG being stored and shall indicate the maximum liquid level of the storage vessel, based on the filling ratio.

#### **5.4.5 Temperature-measuring instruments**

Storage vessels can be fitted with a temperature-measuring instrument of acceptable design and operation. Electronic temperature-measuring devices may also be used.

Bulbs or sensing heads of temperature-measuring instruments shall not be mounted in direct contact with the contents of a storage vessel.

#### **5.4.6 Pressure gauges**

Storage vessels shall be equipped with an acceptable pressure gauge that has a face diameter not less than 50 mm and that is connected to the vapour phase of the storage vessel. Electronic gauging may also be used.

Pressure gauge mounting connections shall be protected internally by means of an excess-flow valve, or by a pressure tapping reduced internally to a bleed hole of diameter not exceeding 1,4 mm.

### **5.5 Mountings and supports**

Mountings and supports shall be so designed that they comply with the requirements of the standard in accordance with which the storage vessel was constructed.

### **5.6 Finish and marking**

#### **5.6.1 Finish**

The outside of storage vessels shall have an approved corrosion protection finish which shall be appropriate to the manner of installation (see also 6.7.2.5).

NOTE LPG is not corrosive to steel and consequently the inside of the storage vessel need not have a corrosion-resistant coating.

### **5.6.2 Permanent marking of storage vessels**

A plate, securely attached in a conspicuous place on the shell of the storage vessel, shall be permanently marked (by the manufacturer) with at least the following information:

- a) the manufacturer's name;
- b) the country of origin;
- c) the vessel's serial number;
- d) the year of manufacture;
- e) the date of initial pressure testing;
- f) the maximum safe operating pressure, in kilopascals;
- g) the design pressure;
- h) the water capacity, in cubic metres (or litres);
- i) the number and title of the standard in accordance with which the storage vessel was constructed;
- j) the minimum and maximum design temperature, in degrees Celsius;
- k) the hazard category in accordance with the requirements of the Pressure Equipment Regulations (PER) of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993); and
- l) a mark of an approved inspection authority or symbol of the manufacturer, as applicable, in accordance with the PER.

### **5.7 Initial inspection, testing and certification**

The inspection, testing and certification of storage vessels shall be under the supervision of an approved inspection authority who shall furnish each storage vessel with a certificate providing, in addition to the information required in terms of 5.6.2, the following information:

- a) the date of test;
- b) the pressure at which the storage vessel was tested;
- c) any other data considered necessary; and
- d) the stamp of the approving authority.

NOTE See also SANS 10227.

## **6 Location of storage vessels**

### **6.1 Risk assessment**

If so required by the approving authority, a risk assessment shall be carried out on each installation. The risk assessment shall be carried out in accordance with the appropriate requirements of the Major Hazard Installation Regulations in the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).

NOTE Where other gases in excess of 4,5 m<sup>3</sup> are stored in conjunction with LPG, a full risk assessment for safety distances should be carried out in accordance with sound fire protection principles.

## **6.2 Above-ground storage vessels**

**6.2.1** Storage vessels shall not be placed beneath any building or in the basement of a building (see also annex B).

**6.2.2** The surface area beneath and around a storage vessel (equal to the footprint of the vessel) shall be made of a non-porous material (concrete or other material), and shall slope away from the storage vessel to the edge of the appropriate safety distance limit (see table 1) or a minimum of 5 m. A typical commercial LPG installation is shown in figure 2.

## **6.3 Buried and mounded storage vessels**

The load imposed by any storage vessel shall not affect other underground structures (for example, foundations, pipelines or sewers). A storage vessel shall not be subjected to loads from vehicular traffic or other surface loading, unless it has been designed and installed to withstand such conditions.

## **6.4 Safety distances**

### **6.4.1 General**

One of the major requirements for an effective and hazard-free fuel installation is that the various components comprising the total installation shall be installed at specific and predetermined minimum distances in relation to each other. These distances are generally known as safety distances.

The appropriate safety distances applicable to

- a) gas fuel installations, are given in figure 3,
- b) combined fuel/gas facilities, are given in figure 4, and
- c) service station (forecourts) installations, shall be as given in B.2.3.

### **6.4.2 Installations involving above-ground storage vessels**

**6.4.2.1** The safety distances applicable to the installation of above-ground storage vessels, shall be in accordance with the appropriate values given in table 1.

**6.4.2.2** Vapour barriers or firewalls, as appropriate, can be used to reduce the distances given in table 1. However, the presence of vapour barriers and firewalls can create significant hazards, for example, pocketing of escaping gas, interference with application of cooling water by the Fire Department, redirection of flames against storage vessels, and impeding ingress of personnel in an emergency.

**6.4.2.3** Special care shall be taken to ensure that where two walls are joined to form an enclosing corner, the angle shall be not less than 90°.

**6.4.2.4** Safety distances shall be measured horizontally from storage vessels where vapour barriers are used. The distance shall be measured in a horizontal line around such barriers. Safety distances shall be measured horizontally and radially from storage vessels where firewalls are used. The firewall shall be at least the height of the storage vessel. (See also 11.4.) Storage vessels shall not be installed one above the other.

**6.4.2.5** The number of storage vessels in any one group shall not exceed six. Unless a firewall is erected between the groups, each storage vessel in one group shall be at least 7,5 m from the nearest storage vessel in another group. When firewalls are used to separate groups of storage vessels, the direct distance from each storage vessel in one group to the nearest storage vessel in another group shall be at least 4 m.

**6.4.2.6** The minimum horizontal separation distance between above-ground LPG storage vessels and above-ground storage vessels containing liquids or gases that have flash points below 93,4 °C, shall be 6 m.

**6.4.2.7** The minimum horizontal separation distance between an underground storage vessel and a second storage vessel, above or below ground, shall be at least 1 m.

**6.4.2.8** The minimum horizontal separation distance between LPG storage vessels and above-ground storage vessels containing liquid oxygen or hydrogen shall be as given in table 2. Where a firewall with a minimum fire resistance rating of at least 2 h interrupts the line of sight between un-insulated portions of the oxygen or hydrogen containers and the LPG containers, no minimum distance shall apply.

### **6.4.3 Installations involving buried and mounded storage vessels**

**6.4.3.1** The safety distances applicable to the installation of buried or mounded storage vessels shall be in accordance with the appropriate values given in table 1. Other parts of the storage vessel shall be not closer than 1 m to a building, boundary or other equipment (see figure 3).

**6.4.3.2** Buried or mounded storage vessels shall be located outside of any buildings. Buildings shall not be constructed over any buried or mounded storage vessels. Sides of adjacent storage vessels shall be separated by not less than 1 m.

**Table 1 — Safety distances**

1	2	3	4	5	6	7
Water capacity of storage vessel  L	Minimum safety distances m					
	From above-ground storage vessel to points of transfer <sup>a</sup>	From above-ground storage vessel to buildings and property boundaries	From buried and mounded storage vessel to buildings, property boundaries and points of gas release	From sealed surface equipment to building and property boundaries	From open flame equipment to building and property boundaries	Between above-ground LPG storage vessels
	500 – 2 250	5,0	5,0	3,0		
2 251 – 9 000	7,5	7,5	5,0			
9 001 – 67 500	9,5	9,5	7,0			
67 501 – 135 000	15,0	15,0	15,0	3,0	5,0	
135 001 – 265 000	15,0	22,5	15,0			
> 265 000	15,0	30,0	15,0			
<sup>a</sup> For points of transfer or filling points see clause 15 and figure 3.						

**Table 2 — Separation distances — Liquefied flammable gases, flammable liquids and oxygen storage**

1	2	3	4
Size of storage			Separation distance
Liquid oxygen vessel	LPG vessel		
	Weight capacity	Equivalent liquid capacity at 15 °C	
tonnes	tonnes	m <sup>3</sup>	m
Up to 200	0,25 to 1,1	0,5 to 2,2	6
	1,2 to 4,0	2,3 to 7,8	7,5
	4,1 to 60,0	7,9 to 117,0	15
	61,0 to 150,0	118,0 to 124,0	22,5
	151,0 and above	125,0 and above	30,0
	LPG cylinders and other liquefied flammable gas <sup>a</sup> cylinders above 50 kg total capacity		7,5
The separation distances listed above for LPG should be applied to the same stored volumes of other bulk liquefied flammable gases and may be used for the same stored volumes of bulk flammable liquids, such as acetone, methanol, diesel, petrol, etc. These distances may be reduced depending on the nature of the flammable liquid and any protective measures, and in these cases an individual assessment of the proposed location shall be carried out.			
<sup>a</sup> Common examples of other liquefied flammable gases supplied in cylinders include ammonia, hydrogen sulfide and ethylene oxide.			

## 6.5 Enclosure of area

**6.5.1** Storage vessels shall not be installed within bunds. However, if the ground surface beneath and around storage vessels slopes towards a driveway or an unprotected work area, vapour barriers shall be provided to prevent spillage from reaching those areas.

**6.5.2** To minimize trespassing and tampering, any area that contains storage vessels, vaporizers, pumping equipment or facilities for loading, unloading and storage vessel filling shall, unless otherwise protected, be enclosed by an industrial-type fence of height at least 1,8 m. At least two means of gaining access to the area in case of emergency shall be provided (see also 11.3.2). The site shall at all times be secured and unauthorized access shall be prohibited.

**6.5.3** Where storage vessels are situated in such a position that they might be subject to vehicle-impact damage, then protection shall be provided (for example, crash barriers, kerbing surrounds or bollards). No vehicle shall be closer than 5 m to the storage vessels unless such a vehicle is compliant with the requirements of SANS 1142.

## 6.6 Warning notices

At least two warning notices shall be securely attached to the outer side of the fence surrounding the storage area. The warnings shall incorporate the pictographs PV 1, PV 2, PV 3 and PV 27 of SANS 1186-1 and be of size at least 190 mm × 190 mm.

**6.7 Installation (see also annex B)****6.7.1 General**

All materials used in the construction of an LPG installation (including non-metallic parts for valve seals, diaphragms, etc.) shall be resistant to the action of LPG under the service conditions to which they are to be subjected. No piping carrying LPG shall be installed in emergency routes required in accordance with SANS 10400. Piping installed in normal escape routes shall be approved by the local authority on the fire protection plan of the building. All installations and maintenance shall be carried out by a registered installer, who is registered for the applicable category of installation.

**6.7.2 Installation of storage vessels****6.7.2.1 Buried storage vessels**

Buried storage vessels shall be installed generally in accordance with NFPA 58.

**6.7.2.2 Mounded storage vessels**

Mounded storage vessels shall be installed generally in accordance with NFPA 58.

**6.7.2.3 Above-ground storage vessels (see figure 1)**

For storage vessels of capacity exceeding 9 000 L, a soil investigation to determine the expected overall and differential settlements shall be carried out before installation. Differential settlement between the two ends shall not exceed 0,4 % of the length of the storage vessel. The storage vessel shall be placed on a slope of 1,0 % with the drain point at the lower end to facilitate drainage of the vessel.

**6.7.2.4 Storage vessel connections**

**6.7.2.4.1** Connections for buried storage vessels shall be on top. Protection against accidental damage for fittings that are at or above ground level shall be provided.

**6.7.2.4.2** With the exception that the discharge, filling and drain lines may be bottom-connected (if the transfer equipment is such that this is possible), where practical, the connections for mounded storage vessels shall be top mounted.

**6.7.2.4.3** Allowance shall be made for any possible future differential settlement between storage vessels and pipework.

**6.7.2.5 Corrosion protection****6.7.2.5.1 General**

Above-ground storage vessels and all pipework, including coating materials and their application shall be corrosion protected. If cathodic protection is applied, readings shall be taken and shall be recorded in a pressure storage vessel logbook. These readings shall be reviewed by a competent person and shall be done to the test requirements of the Vessels Under Pressure Regulations of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).

**6.7.2.5.2 Buried and mounded storage vessels**

Corrosion protection shall be applied in accordance with the appropriate requirements of SANS 1535. Buried and mounded storage vessels shall be protected from loads due to vehicular traffic or other causes, either by erecting a barrier around the area in which the storage vessels are

buried or by protecting the storage vessels with reinforced concrete slabs. If the storage vessel area is not barricaded, the storage vessel manhole cover and the storage vessel fittings shall be protected against tampering. Permanent markers shall be provided to indicate the perimeter of the area under which the storage vessels are buried and a permanent warning sign shall be erected.

#### **6.7.2.6 Storage vessel compounds and bunding**

LPG storage vessels shall not be sited in the same bund area as other petroleum products. No bunding shall be required for pressure-type storage, but a diversion wall can be provided to control a spill. If the storage vessels are fenced or otherwise protected to prevent unauthorized access, ventilation shall be ensured.

### **6.8 Piping**

**6.8.1** Pipes for conveying liquid shall be of steel. Pipes for conveying vapour shall be of steel, solid drawn copper, or in the case of buried pipelines, HDPE. Buried steel pipelines shall have corrosion protection (see also 6.7.2.5).

**6.8.2** Steel piping shall be seamless and as follows:

- a) Where screwed joints are used, these shall be limited to pipes of nominal bore not exceeding 32 mm. Such pipes shall comply with the requirements of BS 1600 for schedule 80 piping or of API Spec 5L (or equivalent). Pipe fittings shall be of wrought steel and of a grade at least equal to that of the mating pipes.
- b) Pipes of nominal bore larger than 32 mm shall have welded or flanged joints and shall comply with the requirements of BS 1600 for schedule 40 piping or of API Spec 5L (or equivalent) or the appropriate requirements of ISO 3183.
- c) The use of steel pipes in critical areas shall be in accordance with SANS 10087-1.

**6.8.3** Copper piping shall comply with the requirements for at least class 1 of SANS 460 for phosphorus de-oxidized copper (Cu-DHP) tubes.

**6.8.4** All pipelines shall be designed to have flexibility to accommodate any settlement of storage vessels and other equipment, thermal expansion and contraction, and any other stresses that might occur in a pipe system.

**6.8.5** Where it is possible for LPG in the liquid phase to be trapped between two valves, a self-resetting hydrostatic relief valve shall be fitted to relieve the pressure that might build up through thermal expansion of the liquid gas. This shall apply in all circumstances even though the space between the valves might be occupied by a piece of equipment, such as a pump casing or a meter. The discharge from the relief valves shall not be allowed to vent to the atmosphere inside a building or to impinge on other parts, e.g. storage vessels.

### **6.9 Valves and other fittings**

**6.9.1** Valves and other fittings shall be of steel with steel trim or of forged brass with brass trim. Cast iron fittings and valves shall not be used, but valves made of nodular iron may be used.

**6.9.2** In the case of commercial butane (liquid or vapour) and propane vapour, flanges and flanged fittings shall comply with the relevant requirements for class 150 of EN 1759-1, and in the case of liquid commercial propane and liquid LPG mixtures (at storage vessel pressure), they shall comply with the relevant requirements for class 300 of EN 1759-1 (or equivalent API and ISO standards).

**6.9.3** The regulating device for the first pressure reduction stage in the vapour discharge line (from the vaporizer) shall be set to reduce the supply pressure to a predetermined lock-up value appropriate to the plant.

**WARNING** Precautions shall be taken to ensure that the pressure does not increase to a stage where the vapour could liquefy.

**6.9.4** Where appropriate, means shall be provided to isolate the vessel, pump and dispenser from each other in the case of fire, or other emergency.

NOTE The actuating means for remote shut off is not specified, but electrical, mechanical, or pneumatic systems may be used.

## **7 Commissioning and decommissioning of bulk tank installations**

### **7.1 Commissioning and certificate of compliance**

All bulk tank installations shall be commissioned in accordance with the requirements of the Vessels Under Pressure Regulations. All installations shall be carried out by a registered installer in accordance with the requirements of the Vessels Under Pressure Regulations and a certificate of compliance shall be issued by a competent person.

### **7.2 Decommissioning of storage vessels**

The following procedure shall be applied before a storage vessel is decommissioned:

- a) Remove as much LPG liquid as possible through the storage vessel liquid withdrawal connection.
- b) Remove as much of the remaining LPG vapour through the venting connection. The vapour shall be burnt-off at a safe location in an approved manner.
- c) Purge the storage vessel in accordance with the appropriate requirements given in SANS 10089-1.
- d) Ensure that flares are at least 5 m away from the storage vessel being purged (see figure 3).

## **8 Filling ratios and volumes of storage vessels**

### **8.1 Filling ratios**

The safe filling ratio of a storage vessel is a function of ambient temperature and relative density. Table 3 gives the appropriate values of the maximum permissible filling ratios for LPG at corresponding relative density.

Where the density of the product is unknown, use a filling ratio of 0,42 (corresponding to a relative density of 0,495 to 0,499 at 20 °C in the case of a storage vessel of capacity less than 4 500 L).



Table 3 — Filling ratio

1	2	3
Relative density <sup>a</sup> of LPG at 20 °C	Maximum permissible filling ratio <sup>b</sup>	
	Storage vessels of capacity less than 4 500 L	Storage vessels of capacity 4 500 L or more
0,495 – 0,499	0,42	0,45
0,500 – 0,504	0,43	0,46
0,505 – 0,509	0,43	0,46
0,510 – 0,514	0,44	0,47
0,515 – 0,519	0,44	0,47
0,520 – 0,524	0,45	0,48
0,525 – 0,529	0,46	0,49
0,530 – 0,534	0,46	0,49
0,535 – 0,539	0,47	0,50
0,540 – 0,544	0,47	0,50
0,545 – 0,549	0,48	0,51
0,550 – 0,554	0,49	0,52
0,555 – 0,559	0,49	0,52
0,560 – 0,564	0,50	0,53
0,565 – 0,569	0,50	0,53
0,570 – 0,574	0,51	0,54
0,575 – 0,579	0,52	0,55
0,580 – 0,584	0,52	0,55
0,585 – 0,589	0,52	0,56
0,590 – 0,594	0,53	0,56
0,595 – 0,599	0,54	0,57
0,600 – 0,604	0,55	0,58
<sup>a</sup> For LPG of known and consistent density, the volumetric fill capacity might exceed 85 % when the values in this table and the formula given in 8.2 are applied.		
<sup>b</sup> This filling ratio will ensure that a storage vessel is never filled to more than 85 % of its water capacity.		

## 8.2 Filling by volume

Because the contents of a static storage vessel cannot normally be controlled by mass, some means is required for calculating the maximum volume of liquid that may be placed in a storage vessel at any liquid temperature. When the temperature of the liquid (obtained by measuring the temperature of the LPG by means of a temperature-measuring instrument placed in a pocket installed in the storage vessel (see 5.4.5)) and the filling ratio are known, the maximum volume of liquid that can be placed in the storage vessel can be determined from the following formula:

$$V_T = \frac{D \times 100}{G \times F}$$

where

$V_T$  is the maximum liquid volume (expressed as a percentage of the total storage vessel capacity) that can be placed in a storage vessel when the liquid temperature is  $T$ ;

$T$  is the temperature of the liquid LPG in the storage vessel, in degrees Celsius;

$D$  is the filling ratio;

$G$  is the relative density of the LPG at 20 °C;

$F$  is the liquid volume correction factor (in accordance with IP 250/69).

The actual maximum quantity, in litres, of LPG that can be placed in a storage vessel is obtained by multiplying the water capacity of the storage vessel by  $\frac{V_T}{100}$ .

## **9 Ongoing inspection, testing and certification of vessels**

Ongoing inspection, testing and certification of the storage vessel shall be carried out in accordance with the requirements given in the PER.

## **10 Testing for leaks**

After assembly, test all piping systems either pneumatically or hydraulically for leaks at the appropriate of the following pressures:

- a) pneumatic testing: 1,1 times the maximum operating pressure; and
- b) hydraulic testing: 1,25 times the maximum operating pressure.

Where pneumatic testing is done, ensure that permission is obtained from the Department of Labour, as required by the Vessels Under Pressure Regulations of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).

After testing, purge-fill all piping systems, thus ensuring that a flammable mixture does not exist in the system.

## **11 Fire hazard control**

### **11.1 Fire safety**

Loose or piled combustible material, weeds and long dry grass shall not be permitted within 3,0 m of any storage vessel.

Access to and around the installation shall be provided for fire-fighting purposes and this area shall be kept free of obstacles at all times.

Since the Fire Control Authority, in whose area LPG storage vessels will be erected, has final jurisdiction regarding the fire hazard involved with such an installation, the relevant Fire Control Authority should be consulted at an early stage regarding the placing of storage vessels and any other guidance with respect to fire-fighting and fire protection facilities.

Such coordination will include the planning for effective measures for control of inadvertent LPG release or fire and the safety of emergency personnel. The provision of acceptable roadways or other means of access for emergency equipment (for example, fire departments) and the effective location and marking of emergency controls, shall be considered.

### **11.2 Passive protection**

**11.2.1** Where fixed sprays or portable monitors or fixed sprays in conjunction with portable monitors are required for protection, a system of passive fire protection can be applied as an alternative.

**11.2.2** Passive protection shall be of such quality that when it is subjected to an acceptable flame impingement for a minimum of 50 min, the shell temperature will not exceed 430 °C.

This requirement shall be verified by means of an approved test method (for example, NFPA 58).

## **11.3 Fire protection**

### **11.3.1 Water supply**

**11.3.1.1** At all installations there shall be a supply of water for fire protection for use in an emergency. To provide protection for a storage vessel threatened by fire, an application rate of 10 L/m<sup>2</sup>/min over the whole surface of the storage vessel for at least 60 min is required. The capacity of the supply might need to be increased where there are no additional water supplies available near the premises. If water is supplied by means of a recirculating system, the storage reservoir shall hold a 30 min water supply. Special consideration shall be given to the possibility that there could be a loss of power on the site and the consequences this would have for the fire protection arrangements provided.

**11.3.1.2** On-site hydrants and fixed drench systems shall be so designed that the water flow can be controlled from a safe position beyond the separation distances given in 17.1. Connections to fixed drench systems for fire brigade use shall be provided on the water supply. The connections shall be located in a safe place agreed with the fire brigade.

**11.3.1.3** There shall be acceptable drainage to deal with water used for fire protection and fire-fighting purposes. Water-sealed interceptors shall be fitted, where necessary, to prevent LPG entering the stormwater drains and sewers.

**11.3.1.4** A summary of the fire protection details are given in table 4. The final system of protection shall be acceptable to the local fire authority.

### **11.3.2 Fire protection details**

The provision for fire protection at fixed installations depends on a number of considerations, including

- a) the maximum storage capacity of the installation,
- b) individual storage vessel sizes,
- c) the number of tanker deliveries, and
- d) whether there is an increased risk of fire on site which might affect the storage vessels, for example at LPG cylinder filling areas (see table 4).

Higher standards of fire protection might be required by the approving authority where other factors prevail, such as increased off-site risks and hazards, location of the nearest water supply and the time for the fire brigade to reach the site (see also annex B).

At remote installations where the population near the storage vessels is low, making it easy to evacuate the area, it might be acceptable for the water supply to be more than 100 m from the storage vessels. In these cases the fire brigade shall be consulted. A comprehensive evacuation plan shall be available and the residents in the vicinity of the installation shall be familiar with it.

At large installations where continuous supervision is available, manually operated water sprays can be sufficient. At these installations it might not be necessary to simultaneously drench all storage vessels and means can be provided to allow drenching of individual storage vessels or groups of storage vessels. A remote manual operating point shall be provided in a safe place.

**Table 4 — Summary of fire protection details**

1	2
Installation capacity L	Fire precautions
500 – 2 250	Water supply for fire brigade use – within 100 m 2 × 9 kg dry powder extinguishers
2 251 – 9 000	Water supply for fire brigade use – within 100 m 20 mm hose reel 2 × 9 kg dry powder extinguishers
9 001 – 45 000	Consideration shall be given to providing a means of applying cooling water to the storage vessels 20 mm hose reel 2 × 9 kg dry powder extinguishers
45 001 – 67 500	Fixed or portable monitors or fixed sprays (or a combination) 20 mm hose reel 2 × 9 kg dry powder extinguishers
> 67 500	Automatic fixed sprays and hydrant and hose 20 mm hose reel 2 × 9 kg dry powder extinguishers
Cylinder filling area	20 mm hose reel 2 × 9 kg dry powder extinguishers
Road tanker filling or deliveries – more than twice a week	Protection appropriate to the site risk 20 mm hose reel 2 × 9 kg dry powder extinguishers

**11.3.3 Precautionary measures**

Fire protection shall be considered under the following circumstances:

- at aerosol filling plants and other LPG filling plants where the storage vessels could be threatened by a fire involving the filling installation or the aerosol store;
- at installations of storage vessels of 67 500 L or greater, the road tanker bay shall be provided with the same level of fire protection as the fixed storage vessels;
- at installations where an average of more than two road tanker deliveries a week take place, or where more than two road tankers a week are filled with LPG, based on the consumption over six months, including the winter period, consideration shall be given to the provision of additional fire protection at the tanker bay; and
- rail loading and unloading gantries shall be provided with fixed water sprays or an equivalent form of fire protection.

**11.3.4 Protection by monitors**

If monitor nozzles are used, they shall be so located and arranged that all storage vessel surfaces likely to be exposed to fire will be wetted.

### **11.3.5 Portable fire-fighting equipment**

There shall be sufficient, acceptable, portable fire-fighting equipment on the premises (see table 4). This equipment shall be selected and located to enable fires adjacent to the storage vessels to be extinguished and so prevent fire spreading to, or jeopardizing, the LPG installation. Fire extinguishers or hose reels or an equivalent combination of these two types of equipment can be provided.

### **11.3.6 Fire instruction and training**

Employees on premises where LPG is stored shall receive instructions with training, as appropriate, to enable them to understand the fire precautions and actions to be taken in the event of fire or leakage of LPG. They shall receive instruction and training appropriate to their responsibilities in the event of an emergency. Those trained to fight LPG fires shall be aware that these fires shall not normally be extinguished unless the source of LPG can be isolated.

At commercial and industrial sites, notices setting out the emergency procedures shall be prominently displayed near the LPG storage area.

## **11.4 Rational design**

In terms of the National Building Regulations, a gas installation is defined as a building. As such, fire protection can be in terms of a rational design as described in SANS 10400.

## **11.5 Protection against static electricity (inductive sparking)**

**11.5.1** Unless other precautions are taken,

- a) an effective earthing connection shall be provided at the discharge point for discharging static electricity from bulk storage vessels; and
- b) provision shall be made for effectively bonding each storage vessel and the delivery storage vessel before and during each delivery operation.

**11.5.2** The storage vessels shall be so electrically earthed as to provide complete protection against lightning and the accumulation of static electricity.

NOTE A resistance not exceeding 10  $\Omega$  is recommended.

**11.5.3** Piping shall be so installed as to ensure electrical continuity, and shall be connected to earth (see also SANS 10089-2). Bonding across flanged joints is not required if the measured resistance does not exceed 10  $\Omega$  (see also SANS 10142-1).

## **11.6 Gas detection systems**

**11.6.1** A combustible gas detection and alarm system shall be installed where unstenched LPG is used at filling and storage sites. Such protection and alarm system shall comply with the requirements of SANS 10139.

**11.6.2** The gas detection system shall be so installed that the gas supply will be closed in the event of power failure to the plant or gas detection system.

## **12 Vaporizers**

### **12.1 General**

**12.1.1** Vaporizers include the following types:

- a) ambient,

- b) low-pressure-steam heated,
- c) hot-water heated,
- d) direct gas-fired (direct-fired), and
- e) electrically heated.

The capacity of the vaporizer(s) installed shall be large enough to supply the latent heat of vaporization necessary to convert the liquid into vapour at the maximum off-take required from the installation.

Where necessary, accumulation of condensate in the vapour discharge line shall be prevented by lagging of the vapour discharge line or, in cold areas, by the provision of condensate pockets capable of containing the quantity likely to be condensed during a plant shutdown. With steam heated and hot-water heated vaporizers, care shall be taken to avoid freezing of condensed steam or water.

Care shall be taken to ensure that the LPG pressure does not exceed the safe working pressure of the vaporizer equipment and that the LPG pressure within the storage vessel is not raised above the design pressure.

**12.1.2** Vaporizers shall not be fitted with fusible plugs.

**12.1.3** Heating or cooling coils shall not be installed inside a storage vessel to act as a vaporizer.

**12.1.4** Manually operated valves shall be installed to shut off the liquid or the vapour connections (or both) between the storage vessel(s) and the vaporizer(s).

## **12.2 Safety distances**

**12.2.1** Direct-fired vaporizers of any capacity shall be located not closer to the nearest storage vessel, storage vessel shut-off valves, point of transfer, building(s) or property boundary than the relevant distance given in table 5.

**Table 5 — Safety distances for direct-fired vaporizers**

1	2	3
<b>Minimum safety distance</b> (see also figure 3)		
m		
<b>To storage vessel</b>	<b>To point of transfer</b>	<b>To building(s) or property boundary</b>
5	6	7,5

**12.2.2** Pressure regulating and reducing equipment shall be protected against radiant heat.

**12.2.3** Vaporizers can be installed in buildings used exclusively for gas manufacturing and distributing operations or, in the case of vaporizers of capacity not exceeding 70 L/h (35 kg/h), in buildings other than those referred to above if the room containing the vaporizer is separated from the remainder of the building by a wall that is designed to withstand a static pressure of at least 5 kPa, and that has no opening or pipe or conduit passing through it. All pressure relief devices shall be vented to a safe area outside of the building.

**12.2.4** Buildings used to house vaporizers shall be of non-combustible materials and shall be well ventilated at both floor and roof levels.

**12.2.5** The electrical components of electrically heated vaporizers shall be manufactured and installed in accordance with the requirements of clause 14.

## **12.3 Design and construction**

**12.3.1** Vaporizers shall be designed, constructed and tested in accordance with an approved standard. All parts of the vaporizers in contact with the liquid LPG shall be of steel or other approved material. The vaporizer storage vessels shall be painted with a corrosion-resistant and light-reflecting paint.

**12.3.2** A plate, securely attached in a conspicuous place to the shell of the vaporizer storage vessel, shall be marked (by the manufacturer) with the following information and any other information required by the relevant statutory regulations:

- a) the manufacturer's name;
- b) the country of origin;
- c) the manufacturer's serial number;
- d) the year of construction;
- e) the date of initial pressure testing (see 5.7);
- f) the design pressure, in kilopascals;
- g) the outside surface area, in square metres (when relevant);
- h) the inside heat exchange surface area, in square metres (when relevant);
- i) the vaporizing capacity, in litres per hour or kilograms per hour;
- j) the number and title of the standard in accordance with which the vaporizer was constructed; and
- k) the electrical details (when relevant).

## **12.4 Fittings**

### **12.4.1 Pressure relief devices**

Vaporizer systems shall have, at or near the point of vapour discharge, at least one pressure relief device. The maximum start-to-discharge pressure of the devices shall be not higher than 110 % of the design pressure of the vaporizer storage vessel.

The pressure relief device(s) shall discharge, at a rate of not less than the appropriate rate shown in table A.1, before the vaporizer pressure exceeds 120 % of the start-to-discharge pressure.

In the case of a direct-fired vaporizer, the discharge from the safety relief device on the vaporizer shall be piped away from any source of ignition to a safe location.

NOTE 1 In the case of relief devices for vaporizers, the total surface area is the sum of the wetted area of the vaporizer shell and the surface area of the heat exchanger. (See table A.1.)

NOTE 2 For vaporizers smaller than those given in table A.1, an approved standard (for example, NFPA or API) should be used.

### **12.4.2 Control of liquid carry-over**

Vaporizers shall have controls to prevent liquid carry-over.

**12.4.3 Heat input control**

The heat input shall be so controlled as to prevent the pressure in the vaporizer storage vessel from reaching the start-to-discharge pressure of the pressure relief device(s) in the vaporizer system. The heat input control shall be suitable for the connection system. The vaporizer shall be connected direct to the liquid phase and may also, when necessary, be connected to the vapour phase of the storage vessel.

**13 Periodic inspection, retesting and maintenance**

**13.1** Any maintenance carried out on the equipment shall be done by a registered installer.

**13.2** All pressure equipment systems shall be tested and inspected in accordance with the relevant regulations of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) or the Mine Health and Safety Act, 1996 (Act No. 29 of 1996).

**13.3** Any leakage from plant, pipelines or piping shall receive immediate attention.

**14 Electrical equipment and other sources of ignition**

**14.1** The sites of the equipment and operations listed in column 1 of table 6 are classified, in terms of SANS 10108, as hazardous locations of the appropriate zone given in column 3, and the extent of each classified area is defined in column 2. Electrical equipment and wiring sited in these areas shall be limited to the types permissible for use in such areas, in terms of SANS 10108 (or other approved standard), and they shall be installed in accordance with the requirements of the statutory regulations of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).

**14.2** Except as allowed in clause 12 in respect of direct gas-fired vaporizers, open flames, cutting and welding operations, portable electric tools, extension lights or any other equipment capable of igniting LPG shall not be permitted within the classified areas specified in column 2 of table 6 unless the LPG facilities have been freed of all liquid and vapour, or special precautions have been taken under carefully controlled conditions.

**Table 6 — Extent of hazard zones for certain specified sources of release for heavier-than-air gases or vapours**

1	2	3
Installation	Extent of classified location (excluding areas beyond an unpierced wall, a roof or a solid vapour-tight partition)	Zone
Storage vessels	Within 5 m (in all directions) of connections other than those covered elsewhere in this table	2
Tank vehicle and tank car loading and unloading	Within 2 m (in all directions) of connections regularly made or broken for product transfer	1
	Beyond 2 m from but within 5 m (in all directions) of a point where connections are regularly made or broken and within the cylindrical volume between the horizontal equator of the sphere and ground level as shown in figure 5.  When the extent of a hazardous location is classified, consideration shall be given to possible variations in the siting of tank cars and tank vehicles at unloading points and the effect that these variations of actual siting point could have on the point of connection.	2
Gauge vent openings	Within 2 m (in all directions) of the point of discharge	1
	Beyond 2 m from but within 5 m (in all directions) of the point of discharge	2



Table 6 (concluded)

1	2	3
Installation	Extent of classified location (excluding areas beyond an unpierced wall, a roof or a solid vapour-tight partition)	Zone
Pressure relief device discharge point	Within the direct path of discharge	1 <sup>a</sup>
	Within 2 m (in all directions) of the point of discharge	1
	Beyond 2 m from but within 5 m (in all directions) of the point of discharge except within the direct path of discharge	2
Pumps, compressors, gas:air mixers, and vaporizers (excluding direct-fired vaporizers) a) indoors without ventilation	Entire room and any adjacent room not separated by a gas-tight partition	1
	Within 5 m of the exterior side of any exterior wall or roof that is not vapour-tight, or within 5 m of any exterior opening	2
b) indoors with adequate ventilation <sup>b</sup>	Entire room and any adjacent room not separated by a gas-tight partition	2
c) outdoors in open air at or above ground level	Within 5 m (in all directions) of the equipment and within the cylindrical volume between the horizontal equator of the sphere and ground level as shown in figure 5	2
Pits or trenches that contain or are located beneath gas valves, pumps, compressors, regulators, and similar equipment a) without adequate mechanical ventilation <sup>b</sup>	Entire pit or trench	1
	Entire room and any adjacent room not separated by a gas-tight partition	2
	Within 5 m (in all directions) of a pit or a trench when located outdoors	2
b) with adequate mechanical ventilation <sup>b</sup>	Entire pit or trench	2
	Entire room and any adjacent room not separated by a gas-tight partition	2
	Within 5 m (in all directions) of a pit or a trench when located outdoors	2
Special buildings or rooms for storage of portable containers	Entire area	2
Pipelines and connections that have operational bleeds, drips, vents or drains	Within 2 m (in all directions) of the point of discharge	1
	Beyond 2 m from the point of discharge, the delimitations given under "pumps, compressors, gas-air mixers, and vaporizers (excluding direct-fired vaporizers)" shall be applied	1
Container filling apparatus	Within 2 m (in all directions) of the filling point	1
	Beyond 2 m from but within 5 m (in all directions) of the filling apparatus	2
<sup>a</sup> Fixed electrical equipment shall not be installed.		
<sup>b</sup> Ventilation, either natural or mechanical, is considered adequate when the concentration of the gas in a gas-air mixture does not exceed 25 % of the lower limit of flammability under normal operating conditions.		

## **15 Filling point for bulk storage vessels**

**15.1** The remote filling connection by which a storage vessel is filled, or through which it fills other tanks, shall be at least

- a) 5 m away from the cylinder filling area (when applicable),
- b) 3 m away from the cylinder storage area (when applicable),
- c) 7,5 m away from the boundary of premises, offices and sales rooms, and
- d) 15 m away from open fires (excluding direct-fired vaporizers) and from schools, places of worship, hospitals and similar institutions.

For safety distances from the storage vessel itself, see the values for F in figure 3.

**15.2** The filling operator shall at all times be in control of both the tanker and storage vessel control valves.

**15.3** If there is a possibility of ignition from a public place, temporary no-smoking signs shall be conspicuously displayed at the public place during discharge operations.

## **16 Filling of portable containers (up to 500 L water capacity)**

**16.1** The filling procedure for portable containers shall, in general, be carried out in accordance with SANS 10087-7. Containers other than those owned by the gas company shall only be filled when permission to fill the portable container has been granted by the owner of the container.

**NOTE** This requirement is solely for safety reasons, since the container containment history is an essential reference for correct filling.

**16.2** The area of the filling site shall embrace the area within a distance of 2 m of the perimeter of the filling equipment and shall allow for the intermediate storage of 1 000 kg of LPG.

**NOTE** This is not applicable when filling a container of 500 L water capacity in situ. For information with regard to filling containers of 500 L water capacity in situ, see SANS 10087-1.

**16.3** The boundary of the filling site shall be at least

- a) 5,0 m away from the boundary of the premises on which it is located,
- b) 5,0 m away from driveways within the premises,
- c) 3,0 m away from any container storage area,
- d) 15,0 m away from outdoor places of public assembly (including school yards, athletic fields and playgrounds, busy thoroughfares and sidewalks),
- e) 15 m away from any permanent open fire, e.g. a boiler room, and
- f) a distance as given in columns 2 and 3 of table 1 away from the storage vessel.

## **17 Container storage areas**

**17.1** The distances between an outside (open-air) storage area for containers (awaiting filling or despatch after filling) and the nearest building, the boundary of the premises, a public thoroughfare

or sidewalk, and the line of an adjoining property occupied by a school, place of worship, hospital, athletic field or other point of public gathering shall be not less than the appropriate minimum distances given in table 7.

**17.2** All containers that are empty (or appear to be empty) shall be handled with the same care as a full container, and the distributing plant operator shall ensure that the valves of all empty containers received for filling are closed properly.

**17.3** Containers shall not be stored within 1,5 m of the edge of a platform at which customers or container-distribution vehicles are served.

**Table 7 — Minimum safety distances**

1	2	3
Total quantity of LPG stored  kg	Minimum distance m	
	From buildings and boundary of the premises	From thoroughfares, sidewalks and line of adjoining property of school, places of worship, etc.
500 – 3 000	3,0	3,0
3 001 – 5 000	7,5	7,5
5 001 – 20 000	10,0	10,0
> 20 000	15,0	15,0

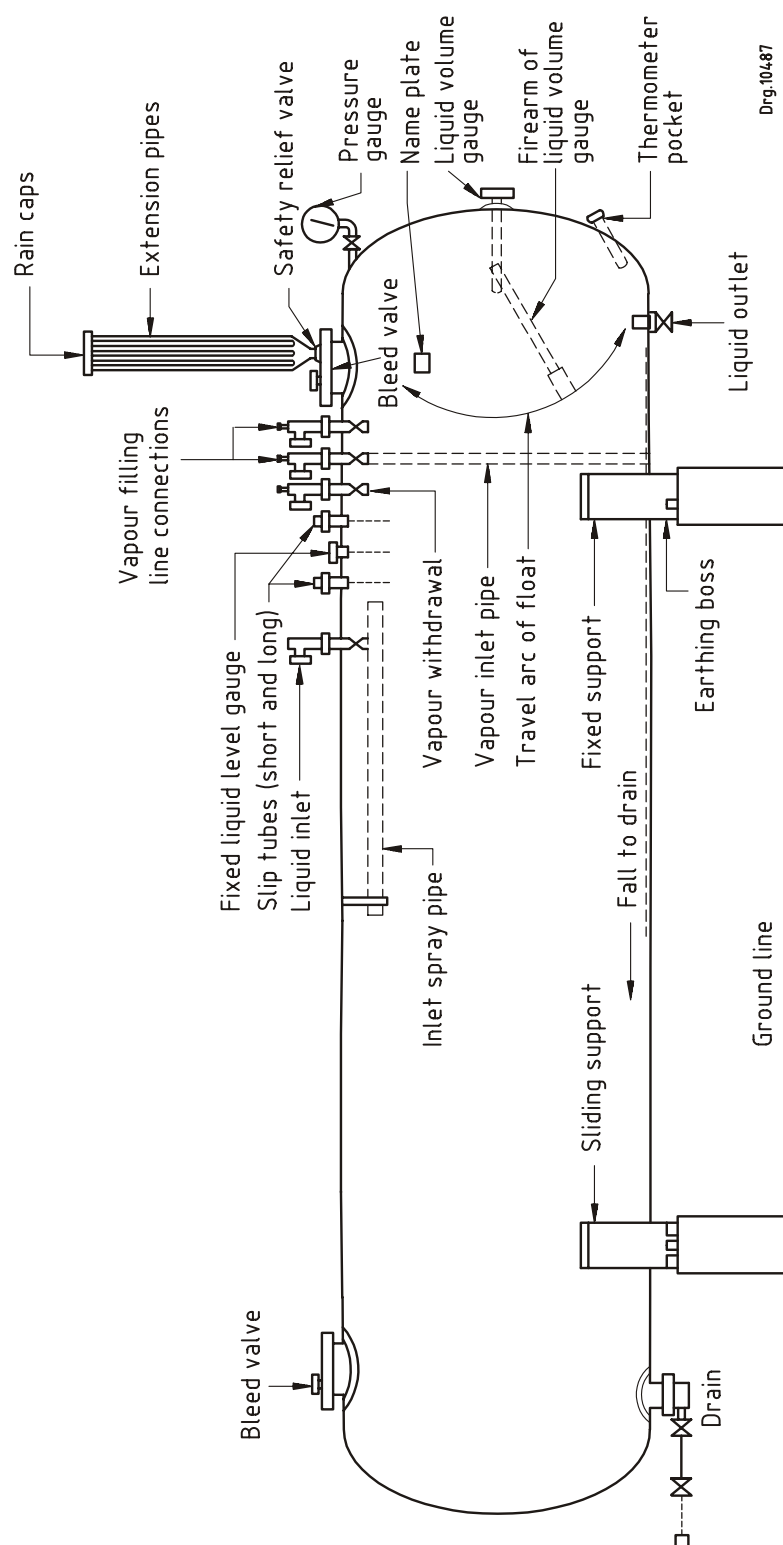
## 18 Filling sheds for portable containers

**18.1** Buildings used for the filling of portable containers with LPG shall be reserved exclusively for this purpose. Floors in the filling area shall have a non-sparking surface and shall not be below ground level. When a raised platform is used, the space under the platform shall either be filled in completely or left open on all sides (to afford free ventilation). In the latter case, the space under the platform shall not be used for any purpose, and shall be kept free from rubbish. Surface water drains (equipped with a gas-liquid separator) situated outside the building shall be provided.

**18.2** Because of the danger of gas accumulations, the formation of pits and similar depressions in the floor shall be avoided. If pits or channels are required for conveyors or other equipment, such pits or channels shall be ventilated by drains that lead to the outside of the building. Such drains shall be so graded as to permit the flow of vapours under gravity, or they shall be connected to forced-ventilation systems.

**18.3** Sheds shall preferably be open-sided, but where it is necessary, because of climatic conditions, to give protection to the workers, ventilation shall be provided at both ground and roof levels. The filling of storage containers shall never be carried out in a cellar or in the upper storey of a building.

**18.4** An automatic or remotely operated shut-off valve for use in emergency situations (for example, gas leakage or fires, etc.) shall be provided on the delivery pipeline (on the inside of the filling shed, at the point where the delivery pipeline enters the filling shed).



**Figure 1 — Typical above-ground LPG storage vessel (side view)**

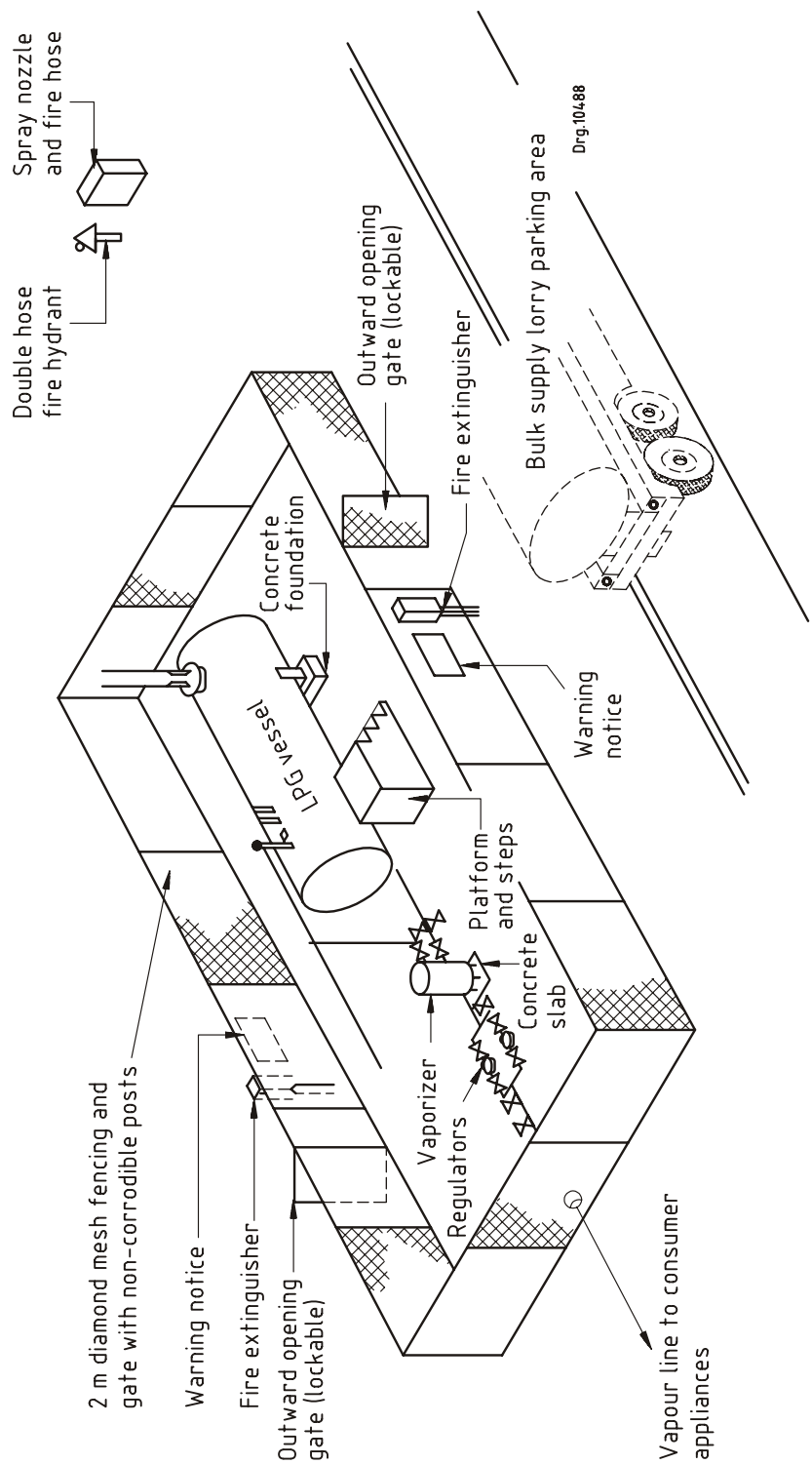
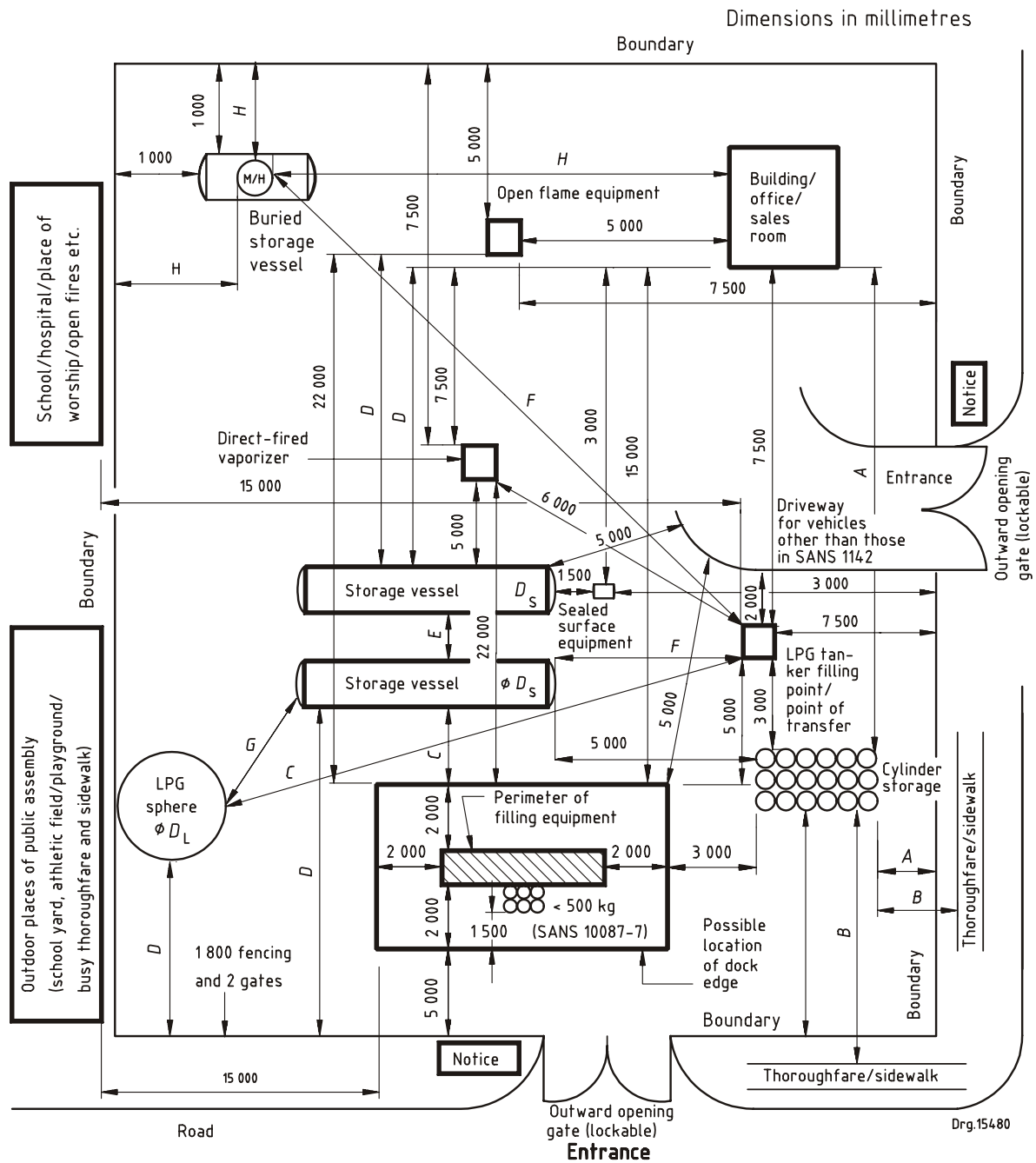


Figure 2 — Typical above-ground LPG bulk storage vessel and vaporizer

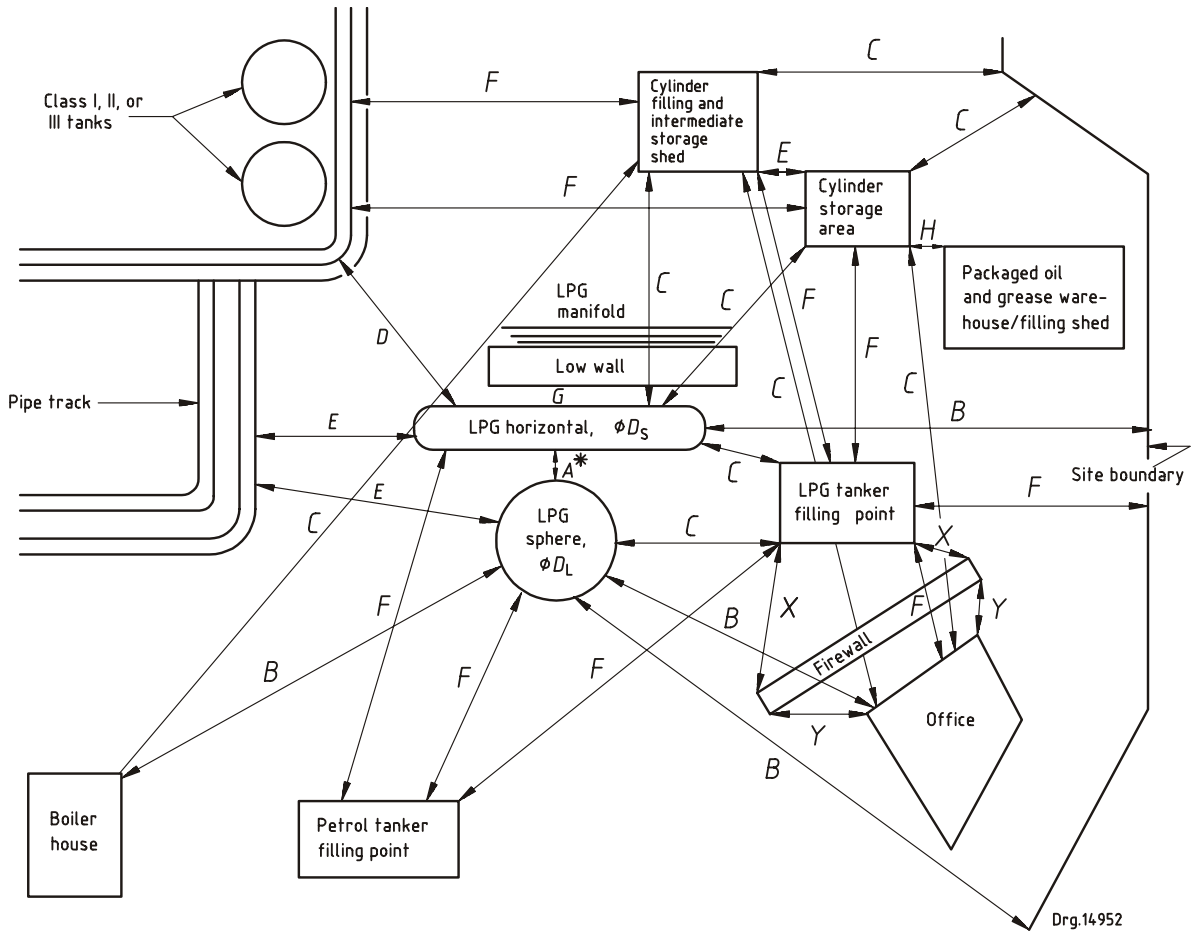


- $D_L$  = diameter (large)  
 $D_S$  = diameter (small)  
M/H = manhole

**Figure 3 — Recommended safety distances for gas fuel installations**

Dimensions in millimetres											
1	2	3	4	5	6	7	8	9	10	11	12
Total quantity of stored LPG kg	A	B	Above-ground vessels	Size of vessel litre water capacity	C	D	E	F	G	H	
500 – 3 000	3 000	3 000		500 – 2 250	5 000	5 000	$\frac{1}{4}$ of sum of diameters of adjacent storage $\frac{1}{2}$ of sum of diameters for vertical vessels	0	$\varphi \frac{D_L + \varphi}{4}$	Buried vessels	3 000
3 001 – 5 000	7 500	7 500		2 251 – 9 000	7 500	7 500		0			5 000
5 001 – 20 000	10 000	10 000		9 001 – 67 500	9 500	9 500		3 000			7 000
> 20 000	15 000	15 000		67 501 – 135 000	15 000	15 000		6 000			15 000
				135 001 – 265 000	15 000	22 500		9 000			15 000
				> 265 000	15 000	30 000		9 000	$D_L$		15 000

Figure 3 — Recommended safety distances for gas fuel installations (concluded)

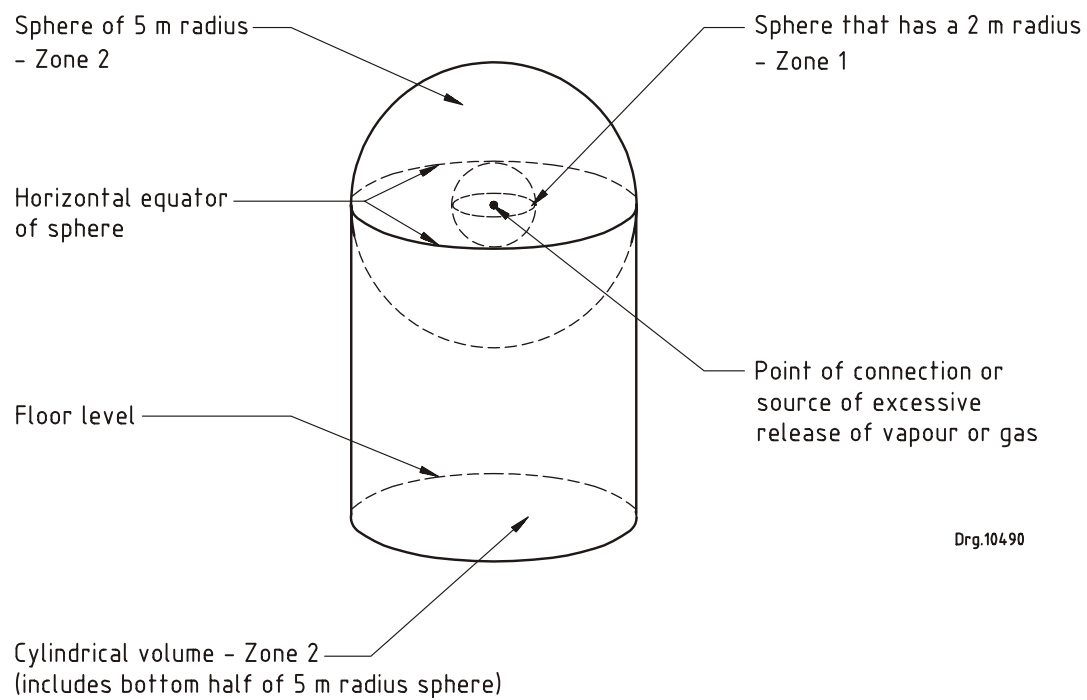


Dimensions in metres

1	2	3	4	5	6	7	8	9	10
Vessel size or description	Safety distances								
	A <sup>a</sup>	B	C	D	E	F	G	H	X + Y <sup>b</sup>
a) Vessel capacity, L									
67 500 – 135 000	–	15	15	15	–	15	5	–	≥ F
135 001 – 265 000	$\frac{D_L + D_S}{4}$	22,5	15	15	–	15	5	–	≤ F
> 265 000	D <sub>L</sub>	30	15	15	10	15	5	–	≤ F
b) Cylinder filling and storage shed	–	–	15	–	10	15	–	–	≤ F
c) Cylinder storage area	–	–	15	–	10	15	–	3	≤ F
d) Intermediate LPG vessel filling point	–	–	–	–	–	15	–	–	≤ F
<sup>a</sup> May be reduced to 8 m if site boundary is a solid wall.									
<sup>b</sup> X + Y shall not be less than 5 m in any case.									

**Figure 4 — Recommended safety distances for above-ground combined fuel/gas facilities**





**Figure 5 — Identification of zone levels**

## **Annex A**

(informative)

### **Rate of discharge of pressure relief devices**

#### **A.1 Surface mounted storage vessels**

The minimum rate of discharge, in cubic metres of air per minute, of pressure relief devices at 120 % of the start-to-discharge pressure is given in table A.1 for storage vessels of surface area up to 200 m<sup>2</sup>.

For storage vessels with a total outside surface area greater than 200 m<sup>2</sup>, the required flow rate in cubic metres of air per minute can be calculated from the following:

$$10,658 A^{0,82}$$

where

$A$  is the surface area of the storage vessel, in square metres.

#### **A.2 Buried and mounded storage vessels**

The minimum rate of discharge may be reduced to 50 % of the appropriate rates given in A.1.

Table A.1 — Minimum rate of discharge for surface mounted storage vessels

1	2	3	4	5	6
Surface area of storage vessel m <sup>2</sup>	Flow rate m <sup>3</sup> of air per min	Surface area of storage vessel m <sup>2</sup>	Flow rate m <sup>3</sup> of air per min	Surface area of storage vessel m <sup>2</sup>	Flow rate m <sup>3</sup> of air per min
1,5	14,9	16,5	106,2	55,0	285,0
2,0	18,8	17,0	108,8	60,0	306,0
2,5	22,6	17,5	111,4	65,0	326,8
3,0	26,2	18,0	114,0	70,0	347,3
3,5	29,8	18,5	116,6	75,0	367,5
4,0	33,2	19,0	119,6	80,0	387,4
4,5	36,6	19,5	121,8	85,0	407,2
5,0	39,9	20,0	124,3	90,0	426,7
5,5	43,1	21,0	129,4	95,0	446,1
6,0	46,3	22,0	134,4	100,0	465,2
6,5	49,5	23,0	139,4	105,0	484,2
7,0	52,6	24,0	144,4	110,0	503,1
7,5	55,6	25,0	149,3	115,0	521,7
8,0	58,6	26,0	154,2	120,0	540,3
8,5	61,7	27,0	159,0	125,0	558,7
9,0	64,6	28,0	163,8	130,0	576,9
9,5	67,5	29,0	168,6	135,0	595,0
10,0	70,4	30,0	173,3	140,0	613,1
10,5	73,3	31,0	178,1	145,0	631,0
11,0	76,1	32,0	182,8	150,0	648,7
11,5	79,0	33,0	187,4	155,0	666,4
12,0	81,8	34,0	192,1	160,0	684,0
12,5	84,6	35,0	197,7	165,0	701,5
13,0	87,3	36,0	201,3	170,0	718,9
13,5	90,1	37,0	205,9	175,0	736,2
14,0	92,8	38,0	210,4	180,0	753,4
14,5	95,5	39,0	215,0	185,0	770,5
15,0	98,2	40,0	219,5	190,0	787,5
15,5	100,9	45,0	241,7	195,0	804,5
16,0	103,5	50,0	263,5	200,0	821,3

## **Annex B**

(normative)

### **Storage and dispensing of LPG as an automotive fuel at service stations or dedicated automotive fuel LPG dispensing sites**

#### **B.1 General**

This annex covers the installation and dispensing of LPG at service stations (forecourts). All above-ground storage vessels shall generally be installed in accordance with the requirements of figure 3.

Operating procedures and requirements for the fuelling of forklift trucks and other LPG operated vehicles shall be in accordance with SANS 10087-8.

Any site shall be under the control of a competent person as defined in the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).

#### **B.2 Construction and design**

##### **B.2.1 Positioning**

The positioning of LPG vessels, especially those above ground, is important especially from a safety point of view. They shall not be positioned under power cables. Distances from the vessel outline shall not be less than 2 m for power cables of less than 1,0 kV and 10 m for cables of 1,0 kV or above. Access shall be available for both delivery tankers and emergency services.

##### **B.2.2 Vessel protection**

**B.2.2.1** Firewalls are permitted on no more than two sides of the compound of above-ground vessels and may form part of the site boundary. For vessels up to 2 500 L, the firewall shall be the same height as the top fitting on the vessels, excluding stack pipes if fitted. For larger vessels the wall height depends both on the vessel height and the distance from the firewall.

**B.2.2.2** Storage vessels may also be placed underground in order to improve the level of protection against potential heat gain from fires in the vicinity.

**B.2.2.3** For mounded and underground vessels, diversion walls may be incorporated on no more than two sides of the compound.

##### **B.2.3 Safety distances**

###### **B.2.3.1 Separation distances (for installations at forecourts)**

Separation distances are established to ensure clearance from a vessel or associated equipment (or both) to other pieces of equipment, buildings or potential sources of ignition which, if these caught fire, would pose a risk to the vessel or the associated equipment (or both).

Minimum separation distances between components are given in table B.1.

**Table B.1 — Minimum separation distances between components**

1	2	3	4	5	6
Components	Storage vessel	Storage vessel fill connection	LPG pump	LPG dispenser	Vehicle being filled
LPG storage vessel	–	See figure 3 and clause 15	1,5 m	1,5 m	$\leq 9\,000\text{ L} = 3\text{ m}$ $> 9\,000\text{ L} = 7,5\text{ m}$
Storage vessel filling connection	See figure 3 and clause 15	–	1,5 m	1,5 m	$\leq 9\,000\text{ L} = 3\text{ m}$ $> 9\,000\text{ L} = 7,5\text{ m}$
LPG pump	1,5 m	1,5 m	–	Nil	Nil
LPG dispenser	1,5 m	1,5 m	Nil	–	Nil
2 <sup>nd</sup> LPG dispenser	1,5 m	1,5 m	Nil	Nil	Nil
Vehicle being filled	$\leq 9\,000\text{ L} = 3\text{ m}$ $> 9\,000\text{ L} = 7,5\text{ m}$	$\leq 9\,000\text{ L} = 3\text{ m}$ $> 9\,000\text{ L} = 7,5\text{ m}$	Nil	Nil	–
Underground petrol vessel manhole with fill connection	7,5 m	7,5 m	6 m	6 m	6 m
Above-ground vessel for liquids < 65 °C flash point	See figure 4				
Remote petrol vessel fill connection	7,5 m	7,5 m	6 m	6 m	6 m
Petrol vessel vents	7,5 m	7,5 m	7,5 m	7,5 m	7,5 m
Petrol dispensers explosion protected	7,5 m	7,5 m	Nil	Nil	Nil
Diesel dispensers explosion protected	3 m	3 m	Nil	Nil	Nil
Parked cars	$\leq 9\,000\text{ L} = 3\text{ m}$ $> 9\,000\text{ L} = 7,5\text{ m}$	$\leq 9\,000\text{ L} = 3\text{ m}$ $> 9\,000\text{ L} = 7,5\text{ m}$	Nil	Nil	Nil
Buildings, boundary or fixed source of ignition	As given in figure 3		6 m	6 m	6 m from vehicle fill point

### B.2.3.2 Installation involving above-ground storage vessels

**B.2.3.2.1** Vapour barriers or firewalls, as appropriate, may be used to reduce the distances given in table 3. However, the presence of vapour barriers and firewalls can create significant hazards, e.g. pocketing of escaping gas, interference with application of cooling water by the fire department, redirection of flames against storage vessels, and impeding ingress of personnel in an emergency. Special care shall be taken to ensure that where two walls are joined to form an enclosing corner, the angle shall be not less than 90°.

**B.2.3.2.2** Safety distances shall be measured horizontally and radially from storage vessels except that, if vapour barriers or firewalls are used, the distance shall be measured in a horizontal line around such walls or barriers. When the storage vessel (excluding stack pipes) is higher than the firewall, the distance shall be measured over the wall.

**B.2.3.2.3** Storage vessels shall not be installed one above the other.

**B.2.3.2.4** The number of storage vessels in any one group shall not exceed six. Unless a firewall is erected between the groups, each storage vessel in one group shall be at least 7,5 m from the

nearest storage vessel in another group. When firewalls are used to separate groups of storage vessels, the direct distance from each storage vessel in one group to the nearest storage vessel in another group shall be at least 4 m.

**B.2.3.2.5** The minimum horizontal separation distance between above-ground LPG storage vessels and above-ground storage vessels containing liquids that have flash points below 93,4 °C, shall be 6 m. The minimum horizontal separation distance between an underground storage vessel and a second storage vessel, above or below ground, shall be at least 1 m.

## **B.2.4 Installation involving buried and mounded storage vessels**

**B.2.4.1** The safety distances applicable to the installation of buried or mounded storage vessels shall be in accordance with the appropriate values given in figure 3. Other parts of the storage vessel shall be not closer than 1 m to a building, boundary or other equipment.

**B.2.4.2** Buried or mounded storage vessels shall be located outside of any buildings. Buildings shall not be constructed over any buried or mounded storage vessels. Sides of adjacent storage vessels shall be separated by not less than 1 m.

## **B.3 Hazardous area zoning**

### **B.3.1 General**

Any equipment containing a flammable liquid or vapour shall be assessed to determine the potential for forming a flammable atmosphere. This is usually called zoning and the zones are divided into

Zone 0: An area in which a flammable gas-air mixture is continuously present or is present for long periods.

Zone 1: An area in which a flammable gas-air mixture is likely to occur in normal operations.

Zone 2: An area in which a flammable gas-air mixture is not likely to occur in normal operations and if it occurs it will only exist for a short time.

By implication, an area which is not classified as zone 0, 1 or 2 is deemed to be non-hazardous or safe with respect to the selection of electrical apparatus.

The final responsibility for establishing zoned areas is with the end user. It is the responsibility of the designer/installer to provide the relevant information.

### **B.3.2 Dispenser zone**

To be consistent with other fuel dispensers, LPG dispensers shall be considered as petrol dispensers with stage 2 vapour recovery but without the vent air separator.

Manufacturers, importers or anyone putting a dispenser on the market shall provide the unit with a diagram showing the relative zoning areas around the unit. When establishing hazardous zones information can be obtained from a variety of sources, including SANS 10108 and SANS 10089-2.

Wiring, junction boxes and glands shall be suitable for the zone in which they are positioned. Installation and testing shall be in accordance with both the relevant standards and the manufacturer's instructions.

## **B.4 Installation**

### **B.4.1 Pumps**

Pumps shall be for LPG use and installed as close as practical to the vessel but not under the contour of the vessel. Submersible pumps may be used in underground vessels. The pumps shall be designed for the hazardous zone in which they are installed.

### **B.4.2 Piping**

Sealants used on threaded joints and gaskets for flanges shall be designed for use with liquid LPG over the safe operating range. Correctly designed and installed flanged joints shall not require additional blow-out prevention (see 6.8).

### **B.4.3 Dispensers**

Although dispensers may in general be considered in the same light as a petrol pump, the following shall be noted:

- a) Dispensers may be placed on the island adjacent to a petrol dispenser and shall be protected against impact by the provision of crash barriers or bollards in the immediate vicinity.
- b) All dispenser bases shall be securely fixed to a mounting island and fitted with anchored shear valves or similar devices.
- c) Each dispenser hose assembly shall be provided either with a pull-away coupling or a safety break connection designed to part at loads of approximately 25 kg to protect the dispenser in the event of a "drive-off" with the hose. The coupling shall be designed to part cleanly and seal both ends to prevent loss of contents.
- d) The hoses shall be in accordance with a recognized and approved standard (for example, EN 1762) for LPG use.
- e) Hose end nozzles shall not allow the flow of product unless connected to a vehicle connection. The hose end nozzle shall be in accordance with an approved standard (see SANS 10087-6).
- f) All dispensers shall be fitted with valves to allow for safe isolation, testing and maintenance. These shall include a return to vessel connection to allow for dispenser testing.
- g) All dispensers used for resale purposes shall comply with requirements of the Trade Metrology Act, 1973 (Act No. 77 of 1973).

## **B.5 Electrical installations**

### **B.5.1 General**

In addition to the relevant requirements given in SANS 10089-3, all electrical and electronic installations shall comply with the requirements of the Electrical Installation Regulations or Electrical Machinery Regulations of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993), together with SANS 1020, SANS 10086-1, SANS 10108, SANS 10142-1 and SANS 10089-2.

Uncertified electrical equipment or systems shall not be installed in hazardous locations (see also figure 5).

### **B.5.2 Emergency switches**

Where the source of supply is in a non-hazardous area, the electrical installation shall have at least an isolation device placed in the non-hazardous area. In the event of excessive distance, the installation shall have an isolation device in an explosion-protected enclosure placed in the hazardous area, to allow rapid isolation. All phases and the neutral shall be isolated, but not the protective conductor. In addition, it shall be possible to de-energize electrical apparatus from any appropriate location if its continued energization would lead to hazards (for example, the spreading of fire). For this emergency switch-off, the operational control unit normally required may be used.

Electrical apparatus, which has to continue operation to prevent additional danger, shall not be included in the emergency switch-off circuit, but shall be on a separate circuit.

Emergency switches connected to the site's main emergency shutdown system, which will isolate the supply to the fuel and LPG systems, shall be provided as follows:

- a) at the control point in the sales building;
- b) incorporated at the main exterior emergency switch of the site; and
- c) in the LPG vessel compound adjacent to each exit.

The electrical circuits to the LPG pump and dispenser shall be arranged such that, on the operation of an emergency switch on the service stations, the LPG pump, dispensers and also the petrol pump and dispensers are all electrically isolated. These shall only be capable of being reset from inside the console area. Emergency switches shall be clearly labelled.

## **B.6 Prevention and control of fires involving LPG**

### **B.6.1 General**

LPG vapours become flammable when mixed with air. Severe fires and explosions can result when such mixtures ignite. The following information is given as a guide to users of LPG:

- a) A liquid leak from an LPG container will generate a very large volume of gas vapour. Liquid leaks are therefore a much greater source of hazard than vapour leaks.
- b) LPG vapours do not disperse easily and, being heavier than air, will hug ground contours and will tend to flow along natural paths and fill depressions, ditches and pits. In favourable conditions, flammable vapours can travel for long distances from the point of release. They might also enter a building and be contained there, particularly in basements and cellars. Vapour dispersal can be accelerated by water spray or wind.
- c) Small fires involving LPG can usually be readily extinguished by dry-chemical-type fire extinguishers. Such extinguishers shall be installed at the filling and storage area.
- d) Empty containers that are left open will admit air. In this way an ignitable mixture that can be very hazardous is formed.

### **B.6.2 Tank installation**

The requirements of this part of SANS 10087 and SANS 10087-1 shall be applied for fire prevention and control measures.



### **B.6.3 Dispenser(s)**

One 9 kg multipurpose dry chemical powder (DCP) fire extinguisher shall be provided per pump island.

### **B.6.4 Gas leakage**

If a leak develops in

- a) a filling container: both the local fire authority and the supplier shall be informed immediately and remedial action shall be taken, or
- b) the supply line: the supply valve on the container shall be closed and remedial action shall be taken.

### **B.6.5 Action in an emergency**

#### **B.6.5.1 Gas leakage without fire**

Unless remedial action, such as closing the valve, can be effected on the spot, a leaking container shall be identified and removed to a safe area.

#### **B.6.5.2 Gas leakage with fire**

**B.6.5.2.1** Unless there is a danger that flames might impinge on other containers, no attempt shall be made to extinguish a fire before the source of the leakage has been determined and it is known that the leakage can be stopped after the fire has been extinguished. For example, a fire occurring at the outlet of a container valve can be extinguished by means of a portable extinguisher, provided that the valve is then closed immediately or the container is promptly removed to a place where gas leakage will not result in a subsequent explosion.

**B.6.5.2.2** Where it is not possible to extinguish the fire and either to stop the leakage or to remove the leaking container promptly, water spray shall be used to keep cool all the containers in the vicinity of the burning fire.

#### **B.6.5.3 Containers exposed to fire**

**B.6.5.3.1** If a container that does not incorporate a safety relief device is exposed to severe heat radiation, acceptable volumes of water sprayed onto the container will cool the liquids and will, in all probability, prevent hydraulic rupturing that could result from over-pressurization. Nevertheless, an assessment shall be made of the risks of possible rupture since such rupture occurs with explosive force and can endanger life and property over a considerable area. The impingement of flames on containers shall be regarded as an extremely dangerous condition that necessitates immediate evacuation of the area.

**NOTE** Evacuation distances will depend on the total volume of gas involved. Evacuation distances of up to 600 m should be considered.

**B.6.5.3.2** Containers not involved in or affected by the fire shall be removed to a safe area or, alternatively, if this is not possible, such containers shall be kept cool by spraying them gently with acceptable quantities of water. If containers equipped with relief devices are exposed to a severe fire, care shall be taken to avoid jets of gas that escape via these devices (for example, by standing well clear of the containers), since such jets might extend as far as 10 m.

## **B.7 Notices**

Notices containing the following warnings shall be displayed at the dispenser:

<p><b>Liquefied petroleum gas</b></p> <p><b>Extremely flammable</b></p> <p><b>Switch off engine</b></p> <p><b>Apply handbrake</b></p> <p><b>No smoking — No naked lights</b></p> <p><b>Switch off cellular phones</b></p>
---

Pictograms shall be used wherever possible. The following additional notice shall be installed at the emergency switch or shall be integrated into the existing emergency switch notice:

<p><b>Emergency — LPG pump</b></p> <p><b>Switch off here</b></p>
--

## **B.8 Filling operations**

The operation of the dispenser shall be via a button on the dispenser, which shall be depressed during operation of the pump. Releasing the button shall stop the flow of LPG.

LPG tanker deliveries shall not be permitted at the same time as a petrol tanker delivery. Only site personnel familiar with operational procedures shall operate the dispenser.

## **B.9 Training**

A written emergency procedure shall be provided at the site and all staff shall be fully trained in the dangers of LPG and on what action to take in the case of an emergency during storage delivery and dispensing. Staff training records shall be kept on site.

Training shall include how to fill a vehicle and what to do if the following occurs:

- a) a customer drives away whilst the hose is still connected;

NOTE Some pull-away couplings can be reconnected with the hose still under pressure. The operator should not do this unless trained to do so. Whatever type of pull away/break away is used, the installation, and particularly hoses, should be checked before the system is returned to service.

- b) a customer arrives at the unit with a different fill coupling than the nozzle supplied;
- c) excess loss of product occurs on disconnection;
- d) the dispenser is collided with;
- e) a user receives a cold burn; and
- f) there is a problem during the tanker delivery.

## B.10 Pressure system maintenance

Maintenance shall only be carried out on the pressure parts of a dispenser by a registered installer who knows and understands the potential hazards involved. To comply with the requirements of the Vessels Under Pressure Regulations as given in the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993), a written scheme of examination is required for any part the failure of which could lead to danger due to the release of pressure. A written maintenance procedure shall also be required.

A schedule indicating typical equipment, which shall be included in a written scheme, is given in table B.2.

**Table B.2 — Typical equipment and test schedule**

1	2	3	4
Typical equipment	Test schedule		
	Annual <sup>a</sup>	Every 5 years <sup>a</sup>	Every 10 years <sup>a</sup>
Base and steelwork	V	—	—
Vessel <sup>b</sup>	V	—	T
Vessel signs <sup>b</sup>	V	R	—
Vessel fittings <sup>b</sup>			
— fill	T		
— liquid out	T		
— liquid return	T		
— vapour return	T	T	R
— relief valve	V		
— pressure gauge	V		
— drain	V		
Filter	—	T	R
Pump	T	R	—
Internal bypass valve	T	—	R
External bypass valve	T	—	R
Hydrostatic relief valve	V	—	R
Test point valves	T	—	R
Dispenser			
Filter			
Measure	T <sup>c</sup>	T	—
Overall			
Hoses <sup>d</sup>	T	R	—
Pull-away coupling	T	—	—
Break-away coupling	V	—	—
Nozzle	T	R	—
V = Visual inspection			
T = Pressure test as given in the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993)			
R = Review			
<sup>a</sup> Intervals shall be specified by the competent person drawing up the written scheme.			
<sup>b</sup> Vessel maintenance is often carried out by the LPG supplier.			
<sup>c</sup> Procedure for testing the volume measure shall take into account typical volumes dispensed and the flow rate applicable to the installation under normal conditions.			
<sup>d</sup> The standard for hoses requires a test at periods not exceeding 12 months.			

## **Bibliography**

SANS 10227, *Criteria for the operation of inspection authorities performing inspection in terms of the Pressure Equipment Regulations.*

© Standards South Africa